Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXIX. NEW YORK, SATURDAY, APRIL 26, 1902. No. 17.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

Copyright, 1902, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, APRIL 26, 1902.

CONTENTS.

	PAGE
Editorial	713
Portrait of Lord Kelvin	716
Mr. Morgan and London Electric Traction	716
Electrical Engineers of the Day—XLIII. H. G. Reist	716
A Central Station Isolated Plant	717
The Divergence of Long Plumb Lines at the Tamarack Mine. By Prof. F. W. McNair	721
Synchronous Reactance. By F. G. Baum	724
A British Refuse Lighting Plant	725
Cost of Construction and Maintenance of Telephone Plants	728
British Telegraph Operators	728
The Reception to Lord and Lady Kelvin	729
Electric Traction for Swiss Railways	730
The Dutch-German Cables	730
Metallurgical Crane	731
Electric Furnace	731
International Association of Municipal Electricians	731
New Telephone Patents	732
Clarkson School of Technology	732
Proposed Independent Telephone Manufacturers' Association	732
Current News and Notes	732
LETTERS TO THE EDITORS:	
Genesis of Wireless Telegraphy. By C. L. Rainford	735
Production of Gutta Percha. By Hy. A. Reed	735
Burning from Arc Rays. By C. H. Hines	735
Digest of Current Electrical Literature	736
New Books	740
New Electric Tonneaus	741
Motor-Driven Plate Bending Rolls	742
Automatic Telegraph Repeater	743
New Marine Generating Set	743
Outlet Bushing	743
DEPARTMENTS:	
Financial Intelligence	744
Commercial Intelligence	744
General News	747
Trade Notes	750
Record of Electrical Patents	751
Portrait of Lord Kelvin	Supplement

KELVIN.

That electrical engineers and men of science should unite to welcome Lord and Lady Kelvin once more to these shores is one of those fit and proper things, so obvious as hardly to need suggesting, and so much in consonance with public sentiment that even the brilliant success of last Monday night at Columbia University may be taken as a matter of course. Lord Kelvin, indeed, does not belong to England alone, but to the world at large, which his genius has made vastly more habitable and comprehensible. If any other country than Great Britain should claim him, however, it might well be the United States, for to him we owe perhaps more than to any other great mind the achievement constituted by the laying and operation of the Atlantic cable. What nobler work can scientific genius find than bringing mankind into closer and more brotherly relationships? Or if it be in the purely intellectual sphere that such an intellect should labor, regardless of human wants and welfare, surely Kelvin again is the man who has linked together not merely hemispheres, but planets and solar systems by the cables of mathematical reasoning and physical demonstration, weighing even the universe in Kelvin balances.

We are glad to know that keen as was the pleasure enjoyed by all who participated on Monday in greeting the great physicist, it was very thoroughly shared by the distinguished guests of the evening. And best of all has been the wider intelligent recognition in the public prints of the value of such work and services as Lord Kelvin has rendered in his day and generation. No better proof could be given that intellect, rather than wealth or birth, still commands here the profoundest respect; and in a democratic community it would be a sad day when that were not the case. It is too much to expect that Lord Kelvin, hale and hearty as he is at eighty, can sustain again the fatigues of an ocean voyage of 6,000 miles; but we shall venture to believe and hope that the cordiality of his reception here and the benefit due to change of air and scene will add many years to a life so rich in achievement of the highest and finest known to man.

INTERNATIONAL SCIENTIFIC RESEARCH.

Last week we commented on the recent able paper of Prof. John Perry on the waste of natural sources of energy, in which the author suggested that a few millions of dollars intrusted to some of our great scientific leaders might result in a solution of the problem how to utilize practically all of the energy of coal, instead of the few per cent. now obtained. In view of the present and rapidly increasing waste of the potential energy of coal, and the consequent rapid exhaustion of coal beds, the matter indeed becomes one that might well interest the civilized governments of the world. Let us hope that at a not far distant day civilized nations will organize scientific research for purposes such as the one here considered. It would probably pay magnificently to commandeer the scientific resources of any or all countries, organize, equip and foster them, not merely for the prosecution of purely scientific research, which carries no immediately perceptible return, but also for humanitarian aims and purposes. This is what scientific research work is seemingly tending to. There is plenty of work being carried on in a disorganized unmethodical fashion. Every man for himself, and Providence for us all, is the motto, but good results are being achieved. Still better results could probably be obtained by forming a scientific trust or co-operation. The astronomers have already done more work in this way in a decade than

by sporadic undirected effort might have been accomplished in several centuries. By international agreement the leading observatories of the world have assumed the photographic charting of certain lots of heaven, so that by final co-operation every nook and corner of the sky will soon have been fully photographed and charted for future astronomical reference. It seems nearly time for the same international spirit to be deflected from heaven to earth. When the plan is attempted, however, it goes without saying that business men, and not scientists—mere children in commercial affairs, as Cecil Rhodes would say—should be placed in charge of the organization, so that the scientists would be relieved of all duties save those of their immediate study.

SYNCHRONOUS REACTANCE.

We publish this week an article by Mr. Baum on "Synchronous Reactance" that merits careful consideration. As is well known, an alternating-current generator-armature possesses at any particular time both a real inductance and an additional virtual inductance. That is to say, the current in the armature establishes magnetic flux that is looped with its own turns, but is not looped with the turns on the field magnets. The amount of this flux, and, therefore, of the real self-inductance of the armature, depends upon the relative positions of the armature and field poles, as well as upon the saturation and reluctance of the local magnetic circuit of the armature turns. It is, in reality, a cyclically fluctuating quantity, capable of being expressed, however, as an equivalent real inductance L, leading to an equivalent real reactance $LI\omega$. But this is not all. The m. m. f. of the armature partially opposes the m. m. f. of the field magnets, the degree of opposition depending upon the lag of the armature current. This produces an effect upon the terminal e. m. f., as though the real reactance were magnified, and the total apparent reactance of the armature is now known as its "synchronous reactance," a term which consequently includes the effects of both real rectance and of armature demagnetizing m. m. f. Mr. Baum's article shows that the assumption of synchronous reactance is only approximately correct, because the demagnetizing vector is not always cophased with the vector of real reactance; but that the error is inconsiderable in computing the effect of regulation. Consequently, the assumption of "synchronous reactance" as the apparent constant reactance of the armature, is sufficiently accurate for practical purposes, if its measurement is carefuly made.

It is claimed that the ordinary method of short-circuiting the armature and determining the excitation that develops full-load current strength is defective, because it necessitates an unduly weak m. m. f. in the field magnets. On the other hand, if this tendency be corrected by employing full excitation and measuring the current strength in the short-circuited armature, the m. m. f. of the armature is unduly great. Another method is, therefore, advocated, of driving the machine as a motor under no load and of super-exciting it until it absorbs the full-load current. There may be some advantage in particular cases of following this method of computing synchronous reactance, but on the other hand it also has disadvantages. The m. m. f. of the field magnets is necessarily above normal, although the m. m. f. of the armature is normal. Moreover, the lag in the machine is abnormal. Experimental comparative data should be collected upon different machines for each of these methods before the value of this plan can be demonstrated.

MASSACHUSETTS CENTRAL STATIONS.

The annual report of the Massachusetts Gas and Electric Light Commissioners is always an interesting document, and the volume for 1901, which lies before us, is no exception to the rule. Indeed, it is more than usually instructive as containing a discussion of several interesting petitions of the commission. First in order of importance comes the matter of "investment," or "capacity," charges by electric light companies. This was brought before the commission by the Woburn Company, to which reference was made at the time in our columns. During the progress of the remonstrance the original plan of a fixed charge amounting to three-fourths of the previous year's bills, plus a small charge of 5 cents per unit net by meter, was dropped by the Woburn Company, and there was substituted for it a sliding scale of "capacity" charges per month, plus 6 cents per unit net. To hold the customer to his capacity one of the automatic limit devices was installed for any consumer under such an agreement. The Commissioners look very much askance at such an arrangement, but as the main objections were removed when the original plan was dropped, they have let the new plan into service, on trial as it were, and await further developments. Their position seems to be that so long as such a scheme is not made a cloak for a rise in prices and is not manifestly unfair to the consumers, they are willing to meet it in a spirit of tolerance and give it a fair trial. We must own that we have never fully made up our minds as to the merits claimed for these plans for charging for capacity. On broad principles a consumer who makes unreasonable demands in the matter of capacity ought to be willing to pay for the privilege. But on the other hand, public-service corporations are likely to be held more and more closely to a uniform basis. If the "capacity" or "investment" charge were carried to its legitimate conclusion the price to certain classes of consumers would become quite prohibitive—a condition which the authorities would not tolerate.

A similar question at bottom arose in the petition against the rates of the Waltham Gas Light Company. In this instance the allegation was that this company had been supplying electric power to the Newton Street Railway and gas to two large consumers at less than the cost of production, and was recouping itself by extortionate charges to the general public. Of course, the fundamental issue was the propriety of extraordinarily low rates to certain consumers, a case implicitly found in instances which ought to involve a heavy capacity charge or its equivalent and yet escape it. The commission censured the policy of the company with respect to the favored customers, but found that, everything considered, the rates to the public were not much in excess of what they should be, and directed only a very moderate reduction in price. In this instance the company was undoubtedly the victim of bad judgment in its railway contract, made in 1893, without sufficient foresight, and now expired. But in discussing the matter the commission laid down a general rule which strikes us as embodying the substantial equities of the situation in a very straightforward manner. It runs as follows: "The general policy of special rates is not to be encouraged, and they can only be justified when they clearly contribute to the general public advantage." This covers the ground admirably and leads to a thoroughly rational view of rates. Incidentally, the Waltham case showed a fine example of special rates to the municipality itself, some forty per cent. lower than those to ordinary customers. This raises a nice question of equity and ethics as to the propriety of the public as a whole receiving concessions to the disadvantage of the public individually—a question which we leave to the industrious casuist. Certainly, most recent rulings tend to encourage electric light companies in the adoption of simple and straightforward methods of metering energy, as free as possible from complications not easily grasped by the public. People instinctively distrust paying upon a basis which they do not quite understand.

Another interesting section of the report deals with the ever-re-

curring topic of municipal plants, including a brief history of the subject in the State. A brief perusal of this renders it very clear that public sentiment in Massachusetts is, as a whole, against municipal ownership. In fact, the Gas and Electric Light Commissioners have powers in that State sufficient to safeguard the public interests quite effectively. The legal status of municipal plants, too, is such that any municipality where there already is a private plant will think twice before listening to the voice of the tempter and going into the business on its own account. Under the Massachusetts statutes a city or town must buy out the existing plant before it can take up municipal lighting, and while this has been done in a number of cases the provisions of the statute as to the principle of valuation involved are so vague that if the existing plant is worth buying there will certainly ensue a long litigation over the price. One such case has to our knowledge been before the courts actively for the last three years, and is not settled yet. As a rule cities are learning wisdom from the experience of others, and fight shy of the electric lighting business. It is safe to say that no lighting company that keeps in touch with its public and takes a broad view of its obligations will see the municipal spectre looming before it under present conditions. We are bound to say that some of the municipal plants recorded are apparently giving pretty good results; but in this case as in the case of private plants, very little can be judged from the face of the returns. The figures given in these Massachusetts reports are anything but conclusive as to the real condition of the plants to which they refer—not through any fault of the commissioners, but simply because there is no generally received system of bookkeeping which renders the full facts available. The general figures are probably very near the truth, but the details are ofter meagre and inconclusive.

Rontgen Ray Burns

Electricity and its applications are responsible for a few special troubles to which flesh is heir. There are, for example, electric shock, telegrapher's paralysis and telephonist's ear, which have been with us for some time; while of late years we have added Röntgen-ray burns. In a recent article appearing in the Philadelphia *Medical Journal,* by Dr. E. A. Codman (8th and 15th March, 1902), the conditions of somewhat less than 200 cases of Röntgen-ray burns are ably discussed. The fact that there have been so many cases reported shows the reality of the danger that exists, and one instance is mentioned of damages for Röntgen-ray burn having been obtained in a U. S. District Court, last November, for the sum of $6,750. The percentage of Röntgen-ray exposures which produce burns appears to be very small. It is estimated at one-tenth of one per cent. in the past five years, and at one-hundredth of one per cent. during the last year. The frequency of burns seems to be diminishing; partly, perhaps, on account of the shorter exposures that are now necessary for radiographs. The article is written by a medical man for medical men, but contains many items of interest for electrical workers, if only because about one-third of the sufferers have been Röntgen-ray workers, many of whom are electricians and not physicians. Prof. Elihu Thomson at one time nearly lost a finger from a burn by Röntgen-rays in the course of experimental study.

It is stated that the cause of Röntgen-ray burns is not known, but that the primary injury is to the nerves controlling the nutrition of the skin, and there is no reliable evidence to show that injury has ever occurred in deeper tissues without primary interference with the skin. It is a matter of common observation that Röntgen-ray workers frequently develop a "sun-burned" appearance over the exposed surfaces of skin. Moreover, just as acute sun-burning will give rise to blistering and destruction of the epidermis, so a more acute influence of Röntgen-rays will give rise to blistering and ulceration. So far, then, the action of Röntgen-rays is similar to the action of bright sunshine, the difference being a matter of relative intensity. At this point, however, the resemblance appears to cease, because Röntgen-rays occasionally extend to the deeper layers of skin and subcutaneous tissues, even to involving tendon-sheaths and joints. This seems to be accounted for by the greater transparency of the body to Röntgen-rays than to solar rays. A curious property of some of these burns is in their tardiness of appearance. While occasionally injuries have been noticed immediately, the average time of first appearance of the burn, from seventy cases tabulated, appears to have been nearly ten days, while a few cases are stated to run into months. A great deal seems to depend upon personal idiosyncrasy. What would have no apparent effect upon one person seems to be capable of producing a severe burn upon another; in other words, some persons seem predisposed to be burned, and no reasons for the predisposition are yet forthcoming, nor can the elect be identified beforehand. Two methods of prevention are known. One is to interpose a metallic shield, generally a thin grounded sheet of aluminum, between tube and patient (why grounded we do not know); while the other is to limit the time of exposure to that which experience indicates as being safe. Dr. Codman favors the latter method, and to that end has tabulated 44 cases for which the distance and time of exposure are recorded. The most sensitive case on this list is one in which a severe burn occurred in 30 mins exposure, at a distance of 50 centimeters. Since the activity diminishes as the square of the distance from the anticathode, this would correspond to four times 30 minutes, or 2 hours, at one meter. Referred to this distance as standard, all the other recorded cases took much more time, the average record showing many hours at a meter.

It is pointed out, however, that the figures are not reliable, because many of them give the distance from the skin to the tube, whereas what is important is the distance from the skin to the anticathode focus. However, it is urged that if the worst case took 2 hours, referred to a meter, a still shorter time, at standard distance, ought to be safe. The article suggests 5 minutes at 10 inches, which means about 77 minutes at a meter. For convenience of memorizing, we may call this safe exposure one hour at one meter, which is half that of the most sensitive recorded case. Since 20 centimeters is a common range between anticathode and skin, the corresponding time of exposure at this range would be the twenty-fifth part of one hour. This is fortunately amply sufficient for the ordinary purposes of either fluoroscopy or radiography, and the principal danger lies in repetition, because the results appear to be cumulative. It seems, therefore, to be clear that where Röntgen-rays are employed therapeutically up to the danger limit, over a particular and localized area of skin surface, it would be well to interpose a stout metallic shield between the tube and the rest of the patient's body.

The tabulation of results on the basis of exposures at inverse squares of distances presupposes that the Röntgen-ray source is equally powerful in all cases, and this is obviously improbable, if not impossible. It is in this direction that research is most needed. The burns are stated to have been caused by tubes that were excited both by static machines, by Thomson induction coils, and by other induction coils. Very little seems to be known as to the conditions of Röntgen-ray source, or of its excitation, which tend to accelerate burning. By all those who use Röntgen-rays frequently, Dr. Codman's articles will be read with interest.

Portrait of Lord Kelvin.

We publish as a special supplement to this issue, a portrait taken this week of Lord Kelvin, who has been kind enough to sit for that purpose at our request to Falk Brothers, in their well-known Waldorf-Astoria studio. It is some years since the familiar photograph of the great scientist was taken, so that we believe our subscribers will welcome this recent picture. Lord Kelvin was kind enough when sitting to express his thanks for the interest thus shown in him in America, and to say how sorry he was not to be able to meet in person all who would look at the picture in a country where electricity through their work had made such wonderful strides. We desire to add that if any of our readers wish to secure copies of the original photograph mounted, they are referred to Falk Brothers direct. Great as are the merits of the reproduction in half-tone, the original photograph, which has been approved by Lord and Lady Kelvin, is also a strikingly faithful piece of work.

Mr. Morgan and London Electric Traction.

It is announced from London that Mr. J. Pierpont Morgan will finance, to the extent of several million pounds, a new underground railroad system in London, which will rival Charles T. Yerkes's scheme of obtaining possession of all the intramural transportation. Combined with the Morgans are Siemens Brothers and other large British interests. The promoters expect that they will meet with but little difficulty in obtaining the permission of the House of Lords Committee for the construction of their lines.

The importance of the scheme consists chiefly in the amalgamation, effected at the end of last week under the Morgans' auspices, of the various projected tubes. These, when constructed, will extend forty miles in a continuous line north, and to the west and southwest of the metropolis. These lines, in turn, will connect with ninety miles of surface roads, the London United Electric Tramways being also a member of the new syndicate.

A special cable dispatch from London, of April 22, says: Clinton E. Dawkins, a member of the firm of J. P. Morgan & Co., testified yesterday before the House of Lords Committee, which is investigating the whole question of London underground transit.

Mr. Dawkins referred to the world-wide character of the financial transactions of the Morgans, who, he said, would guarantee to find the capital for the entire new underground system.

There was no doubt, continued Mr. Dawkins, that the necessary money could be found in England, but if money was cheaper in America it could be raised there. Arrangements had been made to supply the rolling stock without having recourse to America.

Mr. Dawkins referring to the tendency of the population to move away from the congested districts to the outer fringe of London, said he thought this ought to be encouraged on the ground of public health, and pointed out that the only way to relieve the central congestion was to offer rapid transit facilities.

At the resumption of the sittings of the London County Council yesterday strong protests were made by many of the members against the Government's persistent ignoring of the Council's application for powers to build tramways and to give London an organized system of traction. This, it was declared, had resulted in the metropolis being now handed over to the Yerkes and Morgan interests. It was suggested by John Burns, M. P., and others, that the Government should appoint a Royal Commission on this subject, or take other measures for the regulation of municipal traction in order to prevent difficulties arising from the plans of competing foreigners.

The general opinion of the Council, however, seemed to be that it was now too late to appoint such a commission, and after a debate lasting two hours no definite decision was reached.

Electrical Engineers of the Day—XLIII.

H. G. REIST.

Mr. Henry Gerber Reist was born on May 27, 1862, near Mount Joy, Lancaster county, Pa. He is descended from Swiss ancestry, and his forefathers were among the earliest settlers of the State. His early education was obtained in the common and normal schools near his home, and he graduated from Lehigh University in 1886 with a Mechanical Engineer's degree.

Immediately after graduation Mr. Reist obtained a position in Harrisburg, Pa., with the Harrisburg Car Company, manufacturers of engines, boilers and steam-road rollers. His work was in the foundry and machine departments, and consisted of draughting, testing and erecting of machines. In the summer of 1887 he was made assistant superintendent, which position he held until May, 1889. Such a position as Mr. Reist held while in Harrisburg afforded exceptional opportunities for experience in mechanical design and construction, and that these opportunities were not thrown away has been fully demonstrated in his subsequent machine design.

In May, 1889, Mr. Reist resigned his position with the Harrisburg Car Company, in order to accompany the American Society of Mechanical Engineers on their memorable European trip of the summer of that year. About this time his attention was drawn to the probable rapid advancement in the electrical field, and he determined to become identified with that branch of the engineering profession. Following his determination he went to Lynn, Mass., and took a position with the Thomson-Houston Electric Company in the "Expert Course"—as it then was called. A man with Mr. Reist's education and mechanical skill could not remain long in obscurity; he was quickly promoted, and after a few months was assigned to the engineering staff, with charge of development of continuous current

railway generators, the sizes of which were at that time being very largely increased.

When the Thomson-Houston Electric Company and the Edison General Electric Company consolidated in 1893 and formed the General Electric Company, Mr. Reist was one of the first engineers to be assigned to duty at Schnectady, N. Y., the headquarters of the new company. In 1894 he was appointed engineer of the alternating current department, which position he now holds with conspicuous ability. Under his direction most of the modern types of the General Electric Company's apparatus have been developed, ranging in size from fan motors to generators for Niagara Falls, with a capacity of 7,500 kilowatts.

Mr. Reist has taken out a number of important patents, most of them being for detailed improvements in design and construction of the machines which he has brought out. He has read papers before many important engineering societies, notably the American Society of Mechanical Engineers, National Electric Light Association, Ohio Electric Light Association, and Engine Builders' Association of the United States.

Mr. Reist is a true lover of nature, and the search for wild growing things and the study concerning them form his principal and pleasantest pastime. His never failing courtesy and kindly good nature have endeared him to a host of acquaintances and personal friends. He is a member of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, the Franklin Institute, and the American Association for the Advancement of Science.

A Central Station Isolated Plant.

THERE is a degree of sameness about the average isolated plant which often renders descriptions of the same monotonous and uninteresting, especially when there is such a profusion of very large and important plants being installed, many of them on very original lines. The writer believes, however, that a description of the power plant of the Peruna Drug Mfg. Co., of Columbus, O., which is the text of this article, will prove interesting to a large number of readers in view of the high-class of the installation, the diversity of its service and the numerous special devices and their applications.

The plant operates 24 hours a day, and is really a small central station, but supplies a much larger variety of service than the average central station is called upon to furnish. The plant supplies 3,600 16-cp incandescent lamps, 130 enclosed 220-volt arc lamps and an aggregate of 130 hp of motors. Lighting and power are furnished to the Hartman building, Hartman sanitarium, hospital, Peruna factory and shipping buildings, and also to the various stores and shops which occupy ground floor portions of the above buildings. Current is supplied to the various departments and stores by meter, there being 72 Thomson wattmeters on the system. Eighteen arc lamps, burning all night every night, are distributed through the surrounding alleys and passageways, affording no small measure of police protection. In the summer season 85 desk and ceiling fans serve in the various departments. The machinery in the main factory

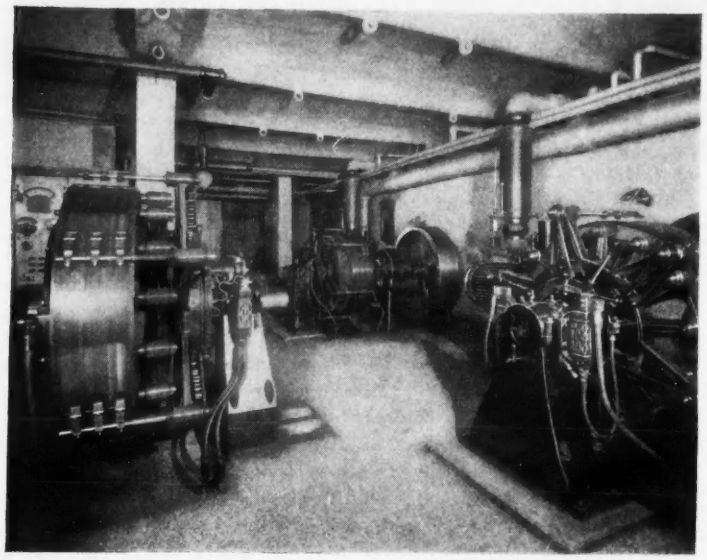


FIG. 1.—GENERAL VIEW, ENGINE ROOM.

building is driven by a 60-hp Corliss engine, which is at present supplied with steam from the power plant boilers about 350 feet distant. This engine will be superseded by a number of line shaft and direct-connected motors.

The various buildings are connected by means of an underground tunnel, a view of which is shown in Fig. 5. The tunnel is 7 feet high and 4 feet wide inside, and 385 feet in length. The small piping on either side are conduits which carry the lighting and power feeders. The arched ceiling of the tunnel carries a 10" heating main, a 6" high-pressure steam line and also smaller piping for the distribution of hot and cold water and compressed air. The tunnel is built of shale brick, plastered and floored with cement, and the tunnel walls and all covered piping are painted with white enamel, the bare piping being finished in black.

In the engine-room, shown in Fig. 1, are three Siemens and Halske, compound-wound, 250-volt generators, which are direct-connected to Ball self-oiling, simple engines, operating at 225 r. p. m. Two of the units are of 75 kw output. Under each generator is a semi-circular pit affording access to the lower brushes. The floor of the engine-room is of mosaic, and the walls, ceiling and all piping are finished in white enamel. Both the boiler and engine-room ceilings are covered with two inches of K. & M. magnesia plastic to prevent the radiation of heat to the store rooms above. There are no out-of-door openings in the engine-room, and the ventilation is effected by a 60-in. Buffalo disc fan, direct driven by a 7½-hp motor, at 400 r. p. m. There are 107 toilet rooms in the Hartman building, which are ventilated by a steel plate exhauster, driven by a 6-hp, slow-speed motor.

The switchboard, shown in Fig. 2, occupies a corner of the engine-room, being bent around the angle of the adjoining walls. The feeder-panel at the right contains 29 switches for lighting feeders. The panel at the extreme left contains 14 power-feeder switches, and also a record sheet showing switch number, size of cable, safe

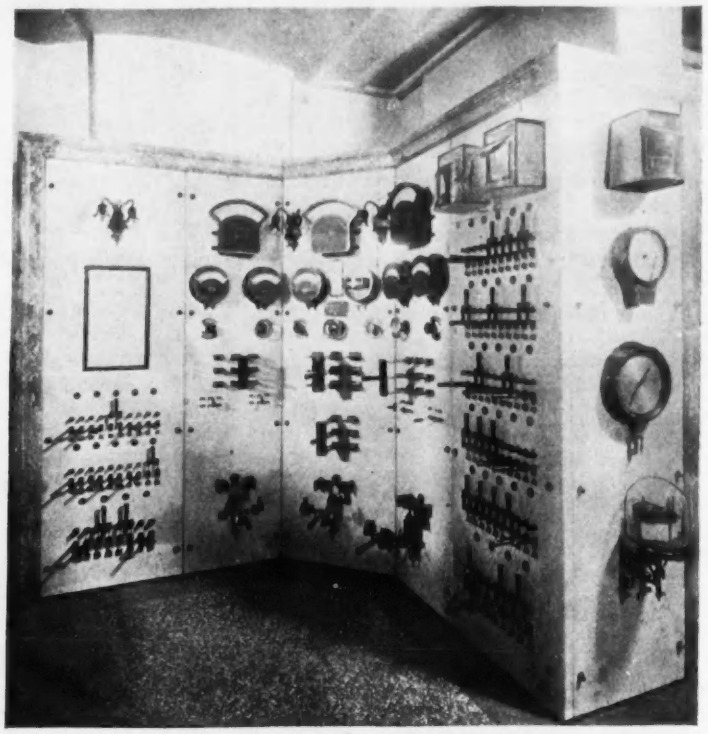


FIG. 2.—SWITCHBOARD.

carrying capacity, proper size of fuse, length of feeder and the location of the distributing cabinet which each feeder supplies. Upon the panel across the end of the switchboard are mounted a total recording wattmeter, a recording voltmeter, a recording steam gauge and also a direct-reading steam gauge. The three generator panels are at the center of the board, the one for the large machine being placed across corner at an angle of 45 degrees from the others. One ammeter indicates the total lighting current and another the total power

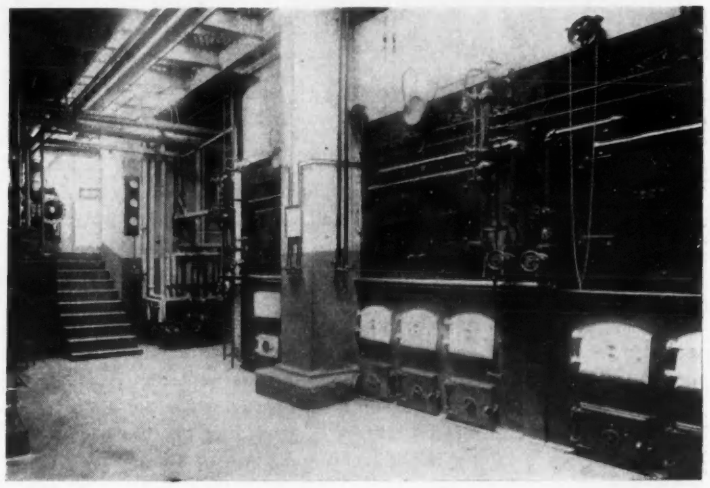


FIG. 3.—GENERAL VIEW, BOILER ROOM.

current. The board is equipped with separate busses for lighting and power, and the generators being equipped with double-throw switches, can be connected to either bus. A switch on the large generator panel parallels the two busses so that lighting and power can be supplied from one generator during periods of light load. The board is equipped with two illuminated dial potential indicators and one voltmeter, which are controlled by double-pole switches for connecting the various instruments to either bus or to any gener-

ator. The voltmeter switch is equipped with extra contacts and connection to ground for measuring insulation resistance. Below the voltmeter is a metal-cased card giving the value in megohms of the various voltmeter readings. The board is of 2-in. white Italian marble and is bordered with a moulding of Scagliola.

In the boiler-room, which is shown in Figs. 3 and 4, are three 72-in. x 20-ft. return tubular boilers, which are connected into the stack by a steel overhead breeching. The smock-stack, which is 4 feet square inside and 150 feet high, passes up through the interior of the building adjoining the freight elevator shaft. The boilers are of 7-16-in. steel with triple-riveted double butt-strap joints, and the shells are fitted with 6-in. tubes riveted into ½-in. flanged heads. The boilers are adapted for 125-lbs. working pressure, and one is equipped with the Hawley down-draft furnace.

There are twenty-four running fountains distributed through the various buildings which are supplied by an 8-in. well 89 feet in depth, the well pump being shown at the left in Fig. 3. The waste water from the various fountains is returned to the vertical drum at the left of the boiler-room stairway, and is delivered to a roof tank by an automatically controlled pump. The waste tank water is again used for boiler feed, for flushing closets and in the various janitors' sinks. The power plant waste and drips are delivered to a hot

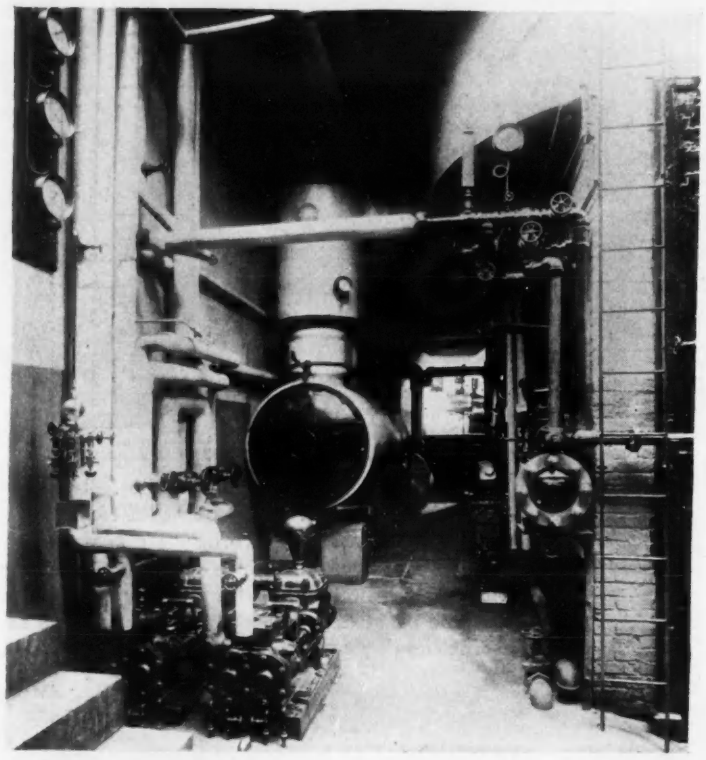


FIG. 4— BOILER ROOM.

well in the boiler-room and are pumped into the city sewer, the boiler-room floor being several feet below the sewer level. On the face of the column in the boiler-room is placed a draft gauge which is connected to each boiler beneath the damper and also into the breeching near the stack. A Hohmann & Maurer pyrometer is placed in the breeching just beyond the last boiler for reading the flue gas temeperatures. A Worthington duplex direct-acting air compressor in the boiler-room supplies the sanitarium, bath rooms and bottle-filling department with compressed air service. An auxiliary air receiver near the compressor is connected with the engine-room and with the rear of the switchboard, providing for the use of compressed air for cleaning the inaccessible parts of the generators and switchboard.

Underground cisterns are provided under the three larger buildings for the storage of rain water; the one under the shipping department being 62 ft. x 26 ft. x 16 ft., that beneath the Peruna building 38 ft. square and 18 ft. deep, and the one beneath the sidewalk of the Hartman building 68 ft. x 18 ft. x 14 ft. Pump suctions from the various cisterns are connected to the power plant, and the large capacity of the storage cisterns insures very soft feed water for considerable periods of time. The depth of water in the various cisterns is indicated in the boiler-room by means of the pneumatic gauges shown in the left of Fig. 4. Duplicate 6 in. x 4 in. x 6 in. boiler feed-pumps are provided, which are so cross-connected that water can be drawn from any of the cisterns, from the roof tank, from the heater or from the city water mains. Water can be delivered without pumping to the heater direct from the well pump, and also from the

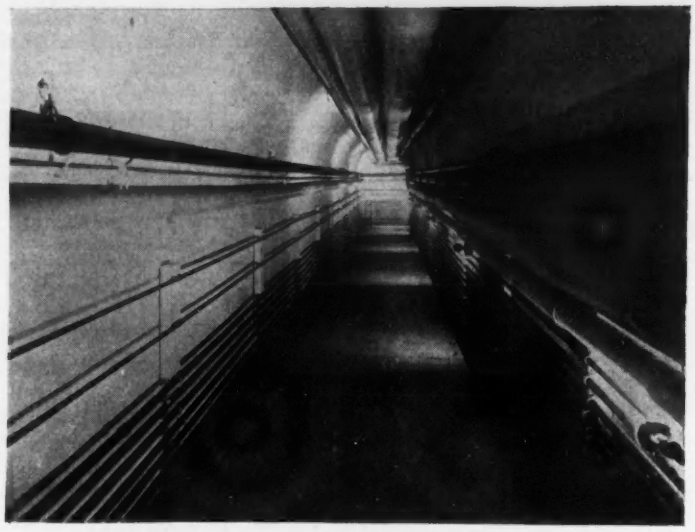


FIG. 5.—UNDERGROUND TUNNEL.

roof tank and from the city water mains. There are about 32,000 square feet of radiating surface distributed through the various buildings, the Warren and Webster system of steam heating being used. The radiators in the sanitarium and factory building are controlled by means of Powers thermostatic valves, the radiator valves being opened and closed by means of compressed air, which is supplied by a small Marsh direct-acting compressor placed in the boiler-room.

Practically all of the exhaust steam, and in extreme weather some live steam, is required for the heating system, all the condensation being returned to the boilers by a duplicate set of direct-acting vacuum pumps. All of the high-pressure drips are carried to an automatic pump and receiver placed beneath the feed water heater, which returns the same to the boilers. In the main feed water line is connected a Ross marine-type filter, which extracts the oil from the steam-heating returns. Immediately above the filter is a 2-in. Worthington hot-water meter for measuring the feed water. An H. & M. thermometer is placed in the feed water main near meter. The connections of filter and meter are so arranged that feed water can be introduced through the meter without the filter, or vice versa,

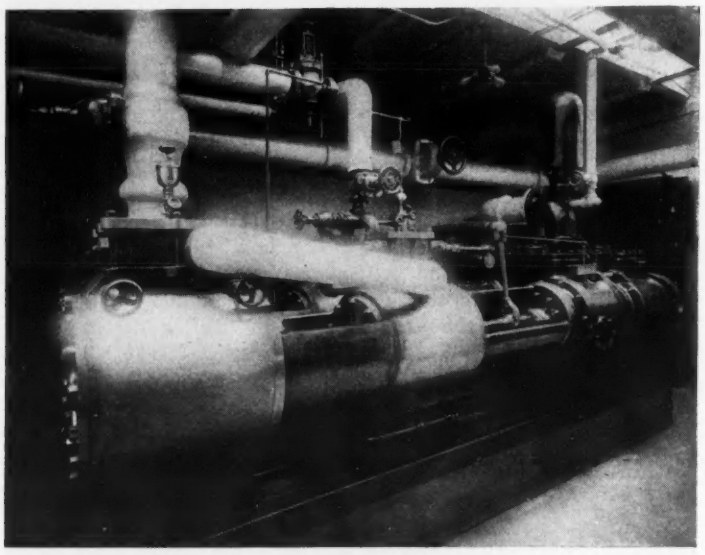


FIG. 6.—ELEVATOR PUMP .

or through both in series. Both devices can be by-passed. A detail of the meter and filter piping and the scheme of connections is shown in Fig. 11.

All high-pressure steam piping is of standard weight pipe and connected with screwed fittings. All valves not used for throttle

valves are Chapman medium-pressure gate valves, fitted with removable bronze seats. The boilers are connected by 6-in. leads into a 10-in. main, which passes over the boilers and around two sides of the engine-room, terminating in a drip leg at the extreme end of the main. Six-inch taps are taken from the top of the main and connected to the engines through a direct separator placed over the engine throttle, a gate valve being placed at the top from steam main. The pop-valve openings on the boilers are fitted with

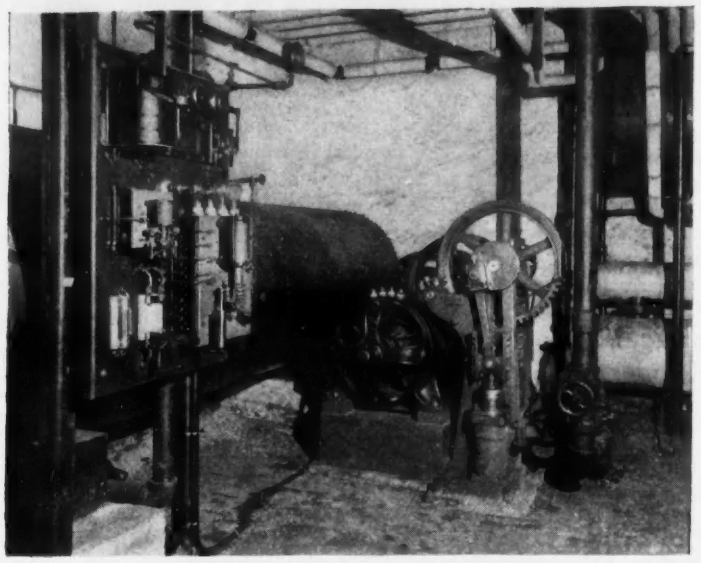


FIG. 7.—PUMP AND CONTROL PANEL.

tees, the pop valve being placed on the top of the tee; the branch outlet of each tee is connected through a gate valve to an auxiliary steam line which connects to the large unit in the engine-room and to the pumps. By means of the auxiliary steam line, any boiler can be connected to the large unit and the pumps, the entire main steam line and its connections being out of service. All hot piping is insulated with magnesia covering, and is finished with white bath-tub enamel. The exhaust from the engines and pumps passes through an 800-hp Hoppes heater, thence through an expansion drum which is mounted over the heater, into a by-pass connection which enters the main exhaust stack immediately below the back pressure valve. The exhaust main, by-pass connection and the 110-ft. exhaust stack are of 14-in. pipe. The blow-off main from the

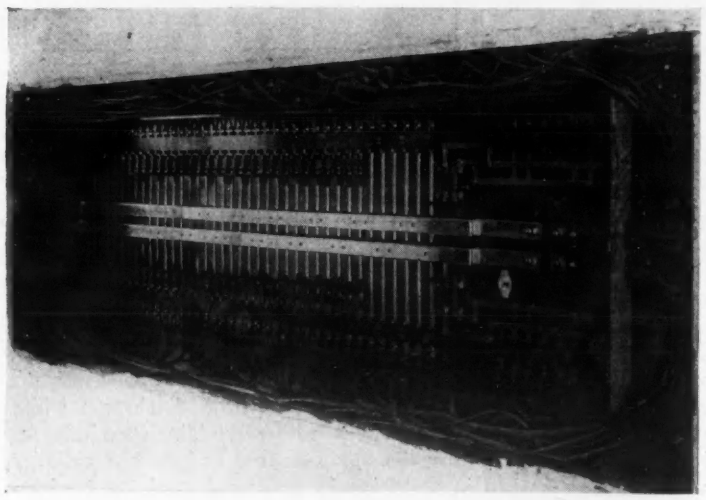


FIG. 8.—DISTRIBUTING CABINET.

boilers is connected with the hot well and also directly with the city sewer.

In the Hartman building are two high-speed Crane hydraulic elevators, one for passengers and one for freight. The elevators travel 370 feet per minute and are fed from a compression tank 84-ft x 18 ft., placed in the basement. The compression tank is served by an automatically-controlled 14 x 20 x 12 x 15 Worthington duplex compound pump, which is fitted with outside packed plungers. The elevator pump, which is set in a heavy cast iron pan, is shown in Fig 6.

The wiring throughout is on the two-wire, 220-volt system, the total drop from switchboard to lamps at full load being 2½ per cent. All wiring is of Habirshaw, double-braided, rubber-covered cable, run in conduits, which are concealed except in the basements. Loricated conduits and Bossert square steel outlet boxes are used throughout. Conduits are fastened into outlet boxes by means of lock nuts, and not more than three bends were permitted in one run of conduit without a straight way box. All conduits are electrically connected and grounded. No wire smaller than No. 14 is used, except in fixtures, and all sizes, including Nos. 14 and 12, are stranded. Practically all of the incandescent lights are on fixtures, there being very few drop cords in use. Many isolated plants after installing a first-class wiring system in conduits, make changes and extensions in a slovenly and unsafe manner with cleat or molding work. The contrary policy has been pursued in this plant, all changes being carried out in accordance with the high class of work in the original installation. The cabinets, one of which is shown in Fig. 8, consist of a ¼-in. sheet-steel box, in which is mounted a tablet board of marbleized slate, removable without disturbing the box or cabinet frame. Where lighting and power feeders enter the same cabinet, they are connected to separate busbars, and the cabinets in the various store rooms are supplied with two sets of busbars, the window lights being connected to one bus and the store lights

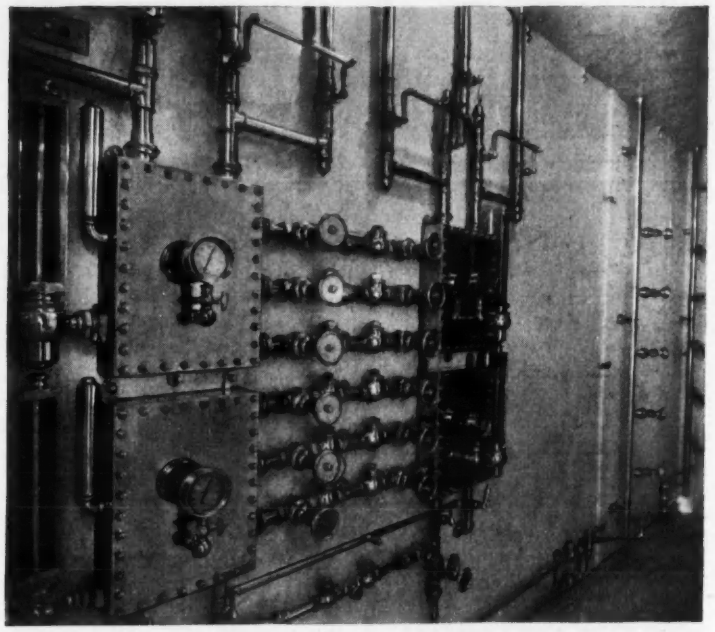


FIG 9.—BATH CONTROLLING STAND.

proper to the other bus. The cabinet doors are of ornamental iron, plate-glass or mirror as the location demands. All distributing circuits are protected by asbestos-covered fuses, and controlled by a double-pole knife switch. All wiring entering cabinets larger than No. 10 have terminal lugs sweated on.

In the factory building is located a 50-number Stromberg-Carlson telephone switchboard. There are 36 central energy telephones distributed through the various departments of the manufacturing plant. The three-wire system is used, and all wiring is of dampproof office wire, run in loricated conduits. A motor-generator set furnishes current for the ringing circuits, and a storage battery supplies the talking circuits. A 200-number Kellogg desk-pattern switchboard is located in the Hartman building, and is connected with 165 central energy telephones, which are distributed through the various departments and suites of the sanitarium. The switchboard is of the lamp-signal pattern, and has trunk connections with the factory switchboard and with the local telephone exchange. The ordinary factory whistle has been superseded by buzzers placed in the offices, and 6-in. gongs placed in the factory rooms, all of which are operated at starting and stopping hours from a Western Union clock, located in the engine-room.

In the sanitarium building are located two large and very elaborately furnished bath departments, one for women and one for men. The water service for the bath rooms is supplied by the 5½ x 8 triplex

pump, which is driven by a 10-hp compound-wound motor. The pump is shown in Fig. 7; the motor control panel being shown at the left of the illustration. The pump delivers water into the compression tank, shown near the pump, from which a cold water main is run directly to the bath rooms. The compression tank serves two 9-ft. Toby heaters, which supply hot-water service to the bath rooms, and also serve a refrigerating chamber which supplies the ice water to the bath rooms.

Electric motors are in use in the various departments of the sanitarium and hospital for driving mechanical massage machines, ventilation fans, ice cream freezers, dish and grocery elevators, sewing machines, etc. The applications of electricity in the bath rooms are numerous, one of the most interesting being the use of incandescent lamps in hot cabinets. A large cabinet is arranged for the introduction of the patient, leaving only the head protruding. The cabinet is lined on all sides with mirrors and evenly distributed on all four sides are 120 16-cp incandescent lamps. These lamps are arranged in circuits of ten each, affording an easy graduation of temperature within the cabinet. It is claimed that the light from incandescent lamps possesses many of the properties of daylight, and the above treatment is said to afford all the benefits of a genuine sun bath.

The sanitarium and hospital have a very complete equipment for the application of electricity to surgery and medicine. A 10-plate 30-in. static machine is used for the Roentgen-ray work, and also for direct applications to the patients. The machine is furnished with a large assortmentment of special electrodes, and by means of a large insulated platform from six to ten persons are often given treatment at the same time. For the application of direct current, a special rheostat is used, the patient is connected in shunt to the main resistance so that he is never subjected to more than the voltage required for current to be applied. The rheostat is equipped

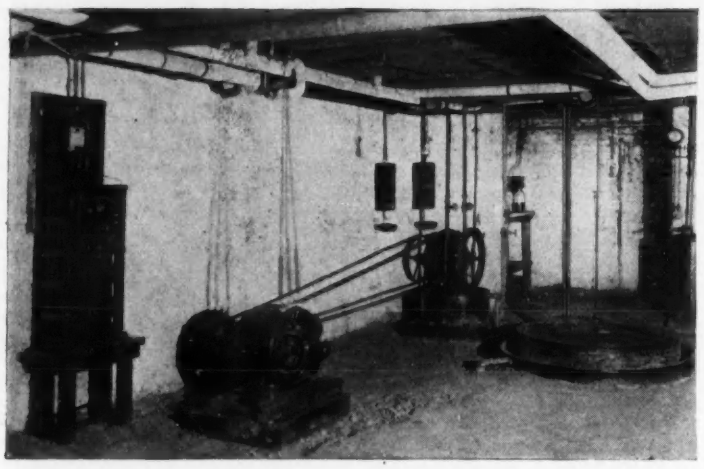


FIG. 10.—OXYGEN GAS PLANT.

with a large circular commutating switch, reversing switch, polarity indicator, milliampere meters and an automatic adjustable circuit breaker. It has two ranges controlled by a special switch, one range giving 43 variations of current between 0 and 60 volts for sensitive work, requiring small current, and the other gives 43 variations between 0 and 120 volts for large currents, and is capable of furnishing 250 milliamperes at 70 volts pressure. The rheostat is also equipped with two special current interrupters, one for high and one for low frequencies.

In the low frequency interrupter the current is broken by means of a clock-driven pendulum, which is equipped with an adjustable weight and gives interruptions from 6 to 600 per minute. The high frequency interrupter is a special form of the ordinary vibrator, the contact being mounted on a swinging arm, which is adjustable so that its position relative to the point where the spring is fastened can be varied. This device gives a very wide range in the higher frequencies. For the application of alternating current a special form of faradic coil is employed which is equipped with two secondaries, one having 5,500 returns and the other 750 returns, the resistance of the former being 350 ohms and the latter 2½ ohms. The pressure in the secondary is regulated by varying its position with reference to the primary windings, a rack and pinion serving to move the secondary back and forth over the core.

The cautery outfit consists of a rotary and a static transformer. The direct-current side of the rotary is wound for 225 volts. Taps from various points of the secondary windings of the static transformer are carried to a circular commutating switch, by means of which the amount of secondary in circuit is varied. By this arrangement the pressure can be varied from 0 to 10 volts, this range being divided into 50 equal steps. The outfit supplies current sufficient for heating the large electrodes to full working temperature. An auxiliary secondary coil is connected directly to a set of terminals for the connection of four-volt examination lamps, which are entirely independent of the regulation of the cautery loops. The above apparatus is all special, and was made to the specifications of the engineer.

In the basement beneath the sanitarium is located a plant for the generation and compression of chemically pure oxygen gas, which is used in the sanitarium and hospital in connection with the administration of anesthetics and also in various forms of treatment. The gas plant, which is shown in Fig. 10, consists of a 2½ x 5 electrically-driven, single-stage compressor, a gasometer, generator and filtering apparatus. The cylinder and valve chambers of the compressor are submerged in running water. The compressor is driven by a 3-hp, slow-speed motor, which is controlled by a speed-regulated rheostat. The gasometer, shown in the right of the illustration, has a

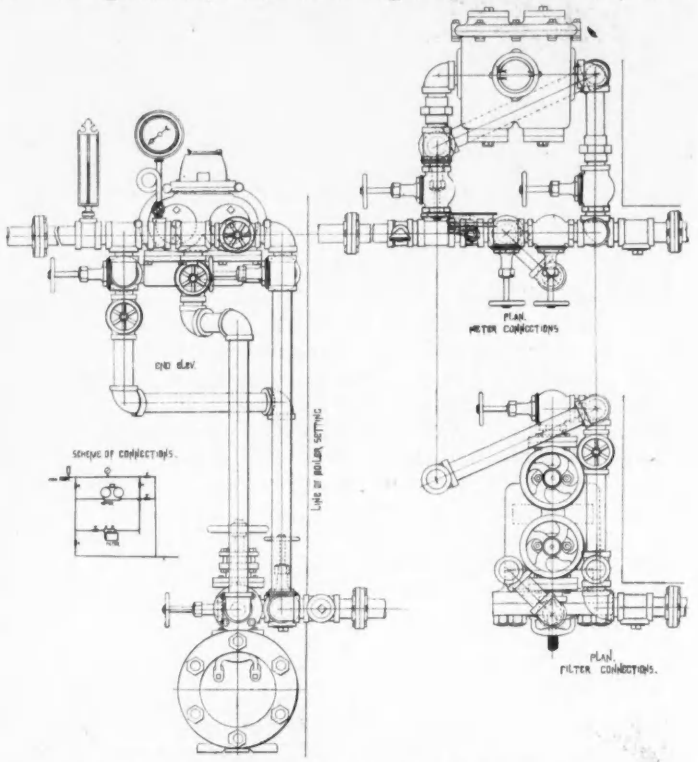


FIG. 11.—DETAIL OF METER AND FILTER CONNECTIONS.

capacity of about 75 cu. ft., and the movable member is over-counterbalanced in order to create a partial vacuum in the filter, which greatly facilitates the flow of gas through the same. The filter consists of a series of large glass jars filled with various acid solutions, and through which the gas is passed.

The gas generator consists of an inclined cylindrical iron retort, which is enclosed in an oven-like case. An iron flame plate is placed beneath the retort to prevent the gas flame from impinging directly upon the retort. To prevent an explosion of the retort the blank end of the same is fitted with a thin cast-iron diaphragm which will rupture at about four pounds pressure. The chemicals are introduced into the retort through the free end of the cylinder, which is closed when in operation by a flanged head fitted with a ground joint. The gas generated from each retort charge is carefully analyzed, and after it has been found to be chemically pure, it is compressed to a pressure of 250 pounds per square inch into small steel cylinders.

When the engineer assumed charge of the work, the generators, engines and boilers had been contracted for, the boilers being already in place. The operation of high-pressure tubular boilers beneath a valuable building in which several hundred persons lived or were employed was, in the opinion of the engineer, an almost criminal practice. Shortly after the plant was started the management, which

is very progressive, consented to change the boiler plant in accordance with the engineer's recommendations, and three 175-hp Babcock & Wilcox cross-drum-type boilers were purchased. From the overhead breeching, carrying gases at 400 to 600 degrees Fahr., considerable heat was radiated to the store rooms above, although the breeching was heavily insulated; it, therefore, was decided to use a down-draft and an underground smoke flue to the stack. One tubular boiler was removed through an opening in the sidewalk, and a water-tube boiler erected in its place, the plant in the meantime operating on the two remaining tubulars. The arrangement of the steel building columns and piping compelled the removal of the boiler farthest from the stack first. This necessitated the construction of a smoke tunnel across beneath the tubulars in operation. Corrugated iron false bottoms were built in the soot chambers, and the rear half of the tubular boilers in operation; the adjacent building wall and the 150-ft. brick stack were supported on I-beams, while the new smoke tunnel was built and connected into base of the stack, a temporary false bottom being built in stack to prevent interference with the draft through overhead breeching. The smoke tunnel footings are 31 feet below the sidewalk level. The first water-tube boiler was placed in operation and the remaining tubulars were removed, and the new battery of water-tube boilers installed with the utmost dispatch. To avoid changes in the position of fittings in the steam line, the new boilers were connected by special bends of extra heavy pipe. The smoke tunnel is of brick and oval in section. The new boiler settings are faced with white enamel brick.

FIG. 12.—HARTMAN BUILDING.

..In connection with the new boiler plant a conveyor system will be provided, which will handle coal and ashes to and from the adjoininig alley, thus avoiding the dust and dirt incident to the handling of fuel in front of the building.

The piping and wiring systems, switchboard, etc., and the details of the entire installation were designed by Mr. Fred W. C. Bailey, a consulting engineer of Columbus, Ohio, to whom considerable credit is due for the successful manner in which the boiler plant changes were effected without accident or interruption of service.

American Capital in London.

A special cable dispatch from London, on April 18, to a New York daily newspaper says: During the course of to-day's session of the Select Committee of the House of Lords, appointed to inquire into the merits of the various proposed railroad schemes for London, the opponents of some of Charles T. Yerkes's plans objected to the introduction of American capital, contending that all orders for the machinery and equipment required for Mr. Yerkes's schemes were going to the United States. Lord Knutsford, formerly Colonial Secretary, and a member of the committee, interposed and remarked that the committee did not care whether the capital was American or British, so long as the committee was satisfied that the lines would be properly financed.

The Divergence of Long Plumb Lines at the Tamarack Mine.

By Prof. F. W. McNair.

In September last it was my fortune to be present, together with Professor James Fisher, of the College of Mines, at a "Plumbing" of No. 5 shaft of the Tamarack mine. The plumbing was under the direction of Mr. J. B. Watson, the chief engineer for the Tamarack Mining Company.

The method employed was the well-known one of transferring an azimuth from surface to some underground level by means of two plumb lines hung in the shaft. The remarkable feature lay in that the depth of the chosen level, and, consequently, the length of the lines were greater than in any previously recorded instance. The lines as hung were 4,250 ft. in length; they were of No. 24 piano wire, and the bobs were of cast iron, weighing 50 pounds each. The latter were swung in pails of cylinder oil for damping the vibrations. Great care was taken that the lines should be free, and that they should be protected at the bottom from dropping water, of which, indeed, there is not a great deal in the shaft. No attempt was made to completely stop vibration. Scales were erected behind each wire, and its mean position determined by observing the extent of the swing.

When the wires had settled into a state as near quiescence as it was expected they would come, a check measurement was taken between them at surface, and between their lower extremities at the 29th level. The upper measurement was 16.32 ft., that below 16.43 ft., showing a divergence of the lines to the amount of 0.11 ft. As the west wire, which had been lowered in the center of the shaft compartment in which it hung, had been moved to the east until it was about half a foot from the dividers between that and the next compartment, it was inferred that some projecting object might be interfering with its freedom. A careful exploration of the shaft, occupying between two and three hours, revealed no such interference. To make certain, however, this west wire was moved westward toward the center of the compartment 1.26 ft. When all was quiet again, measurements as before were taken, showing a distance at surface of 17.58 ft., and at the 29th level of 17.65 ft., there being yet a divergence of 0.07 ft.

Possible causes were at once freely discussed among those who were present. Gravitation being suggested, I drew attention to Newton's theorem of the attraction on a mass within a closed spherical shell, adding that the same must be true in a tube of great length. I was inclined to explain the divergence on the theory that the air pipes in the west end of the shaft (of which there are two, a 16-inch in the northwest corner, and a 4-inch one near the southwest corner) were acting as magnets, and, because of its proximity, were attracting the bob on the west wire out of its normal position. The distance from the west bob to these pipes was something like seven feet. The east bob being 24 or 25 feet away would of course be affected to a much less degree. The behavior of the west wire seemed to confirm such a theory. There was considerable torsional vibration in both wires, and it seemed that a slight horizontal polarity in the west bob, which would at times coincide with, and at others oppose the field created by the pipes, might account for the observed irregularity in the vibration of this wire when compared with the vibration of that hanging in the east compartment. The latter remained remarkably steady throughout the entire time it was under observation. Under the circumstances I advised the use of lead bobs in a plumbing of No. 2 shaft, which took place about a week after that at No.5. I did not advise a change to wire of non-magnetic material, for it did not appear to me that polarity in the wire, which would of course exist, could develop sufficient force to bring about the observed divergence.

To my surprise, Mr. Watson reported that the wires hung in No. 2, although about 120 ft. shorter than in No. 5, and although lead bobs had been used, yet showed a divergence of 0.10 ft., and, further, that, from comparison with other surveys, he had reason to believe that the azimuth of the wires at the bottom was considerably greater than at the top. At the surface they were 12.60 ft. apart. An examination of the magnetic conditions yielded a possible explanation of the greater azimuth in that the air pipe in the southwest corner of the shaft terminated not far below the bob on the west wire. A repulsion between the lower end of this pipe and the lower end of the west wire, presumably of the same north polarity, might account for

the increased azimuth. It could not, however, account for the divergence.

The publication about this time in the Portage Lake Mining *Gazette* of the fact that a divergence in the plumb lines had been observed, attracted considerable attention, and brought forth many attempts to explain its existence. Those most familiar with the conditions had no satisfactory theory to offer. To them it was evident that more data must be secured before the cause could be correctly assigned.

Among the proffered explanations, two are worthy of notice. The first was that the divergence was due to the greater attraction of the material at the end of the shaft for the bob hanging nearest it. It it remarkable how many trained persons, engineers and others, held to this view. There seems to exist a general lack of appreciation of the forces of gravitation, except in the single instance of the force between the earth and objects upon it. It is, of course, true that the attractions on each bob toward the ends of the shaft are different, the stronger being toward the end nearest to which the bob hangs. Further, these differences tend to diverge the wires, but their amounts are so insignificant as to put them quite out of consideration. The sum in this case is only a few hundredths of a grain, and the consequent divergence about a thousandth of a foot.

The second explanation worth notice was offered by Professor William Hallock, of Columbia University. This was that of mutual repulsion between like poles at the lower extremities of the wires.

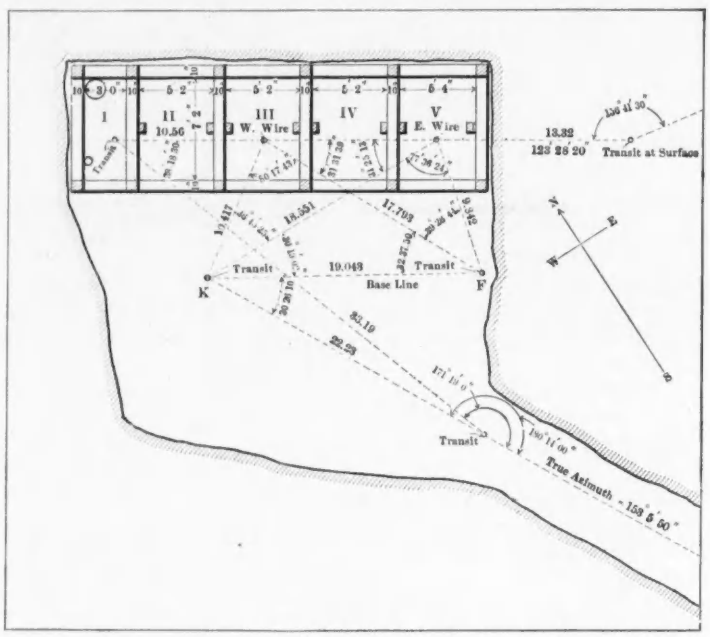


FIG. 1.—TRIANGULATION, 4,163 FEET BELOW SURFACE.

It was subsequently modified (see ELECTRICAL WORLD AND ENGINEER, Feb. 8th, 1902) to include as well repulsion between like consequent poles distributed along the wires.

Meantime the management of the Tamarack Mine, with its characteristic interest in scientific things, had granted me permission to carry on further experiments in No. 4 shaft. This shaft is particularly adapted to experiments of this kind, especially as it is much freer from magnetic material than any of the others. Mr. Watson entered heartily into the project, and the experiments which were conducted were hardly less under his direction than mine. The actual work was shared by Professor Fisher and Instructors N. S. Osborns and E. D. Grant, of the College of Mines, and by Mr. Slock, assistant engineer at the mine. Phosphor bronze wire No. 20 B. & S. gauge was chosen for the lines; 60-pound lead bobs were hung at the bottom, first in oil, but subsequently in water, the latter being found by far the most satisfactory medium. These lines were hung as far apart as the conditions in the shaft would permit, and were approximately 4,440 ft. in length from point of suspension to bottom of the bob.

Means were taken to locate the wires in a horizontal plane. At first a base line was laid off for each wire. The wire was observed by transits simultaneously from both ends of the line, and the two wires were under observation at the same time. This scheme was almost immediately abandoned for the simpler one of a single base line common to the two wires. A transit was mounted at either end of the base, and it observed alternately each wire. The method is exhibited in Fig. 1, which is a horizontal cross-section of No. 5 shaft at the 29th level, and also in Fig. 2, a cross-section of No. 4 shaft at the 11th level. In each figure *W* and *E* are the positions of the wires, while *K* and *F* in the one and *F'* and *C'* in the other are those of the transits. In each case the base line was tied to permanent marks in the neighborhood of the plat at which the observations were taken. Scales were erected behind the wires in a position perpendicular to the line of sight and as near the wires as was convenient. Most of the time a scale in sixteenth inches numbered decimally was used. At first the wires were allowed to vibrate as they would, but for most of the observations they were set vibrating parallel to the scale on which it was desired to read mean position by drawing them aside from half to three-quarters of an inch, then allowing them to swing freely. An odd number of readings was taken, as in the method of determining the zero point of a balance by observing the vibrations of its pointer. Great care was taken to protect the wires as far as possible from disturbing influences, such as currents of air and dropping water.

As showing the constancy of the mean positions of the wires, it may be of interest to quote an example from observations at No. 4 shaft, and one from No. 5. I quote, from the note book, observations at No. 4 shaft, Jan. 9, 1902:

Station C1, east wire, McNair.

Left.	Right.
56.6	63.4
58.1	64.3
60.5	65.5
59.0	62.8
60.7	65.4
59.3	62.2
57.0	

Mean position, 61.3.

Station C1, east wire, Watson.

Left.	Right.
51.0	74.5
57.5	67.5
55.0	68.0
50.5	70.5
56.0	67.0
59.5	66.5
57.3	64.2
	66.8

Mean position, 61.7.
Mean of the two sets, 61.5.

The interval of time between the above sets is not recorded in the note-book, but is remembered as being between one and two hours.

Again, from the note-book, No. 5 shaft, Feb. 23, 1902.

Station F, west wire, Osborne.

Left.	Right.
44.5	60.6
45.3	60.2
45.9	58.7
49.2	56.6
49.0	56.4
49.1	56.0
48.8	

Mean position, 52.8; time, 11:40 *a. m.*

Station F, west wire, Fisher.

Left.	Right.
47.3	58.3
49.7	57.8
49.9	56.2
52.0	54.6
	54.7

Mean position, 53.0; time, 3:40 *p. m.*
Mean of the two sets, 52.9.

It will be seen from these examples that the mean positions of the wires were very constant for considerable periods of time.

The angles in the figures were read by repetition to some mark of the scale near to the mean position. They were afterwards corrected for the difference between the mark chosen and the mean

position of the wire assumed from the observations. Check measurements of distances from instruments to wires were taken, the wires being held as near as might be in the mean positions. It is thought that the distance between the mean positions of the wires was determined with an error not greater than 0.003 ft.

After hanging the bronze wires in No. 4 shaft and finding a small convergence, it was decided to hang the steel wires in this shaft in the same position at the top as the bronze lines, and note their positions at the bottom, both with lead bobs and with iron bobs. The bobs were first in oil, subsequently in water. The results for distances between the wires are exhibited in the following table:

Plumb Lines in No. 4 shaft, Tamarack Mine.

Date. 1902	*Wires.*	*Bobs.*	*Medium.*	*Distances in Feet.* Surface.	11th Level.	*Convergence. In feet.*
Jan. 3	Bronze.	Lead.	Oil.	15.089	15.061	0.028
Jan. 6	Steel.	Lead.	Oil.	15.089	15.074	0.015
Jan. 6	Steel.	Lead.	Water.	15.089	15.074	0.015
Jan. 6	Steel.	Iron.	Water.	15.089	15.062	0.027
Jan. 9	Bronze.	Lead.	Water.	14.607	14.611	*0.004

*Divergence.

Whatever might be the cause for the slight convergence observed, the results of these observations seemed to afford ample experimental proof that neither gravitation nor magnetism could account for the divergence originally observed in No. 5 shaft. The shorter distance between the bronze wires as hung the second time was due to the necessity for moving the western one to avoid contact with pieces of steel wire which were lodged in the west compartment on the breaking of the line which had hung in this compartment on the 6th of January. After the compartment was supposed to be clear, the west wire was moved east to ensure further its freedom.

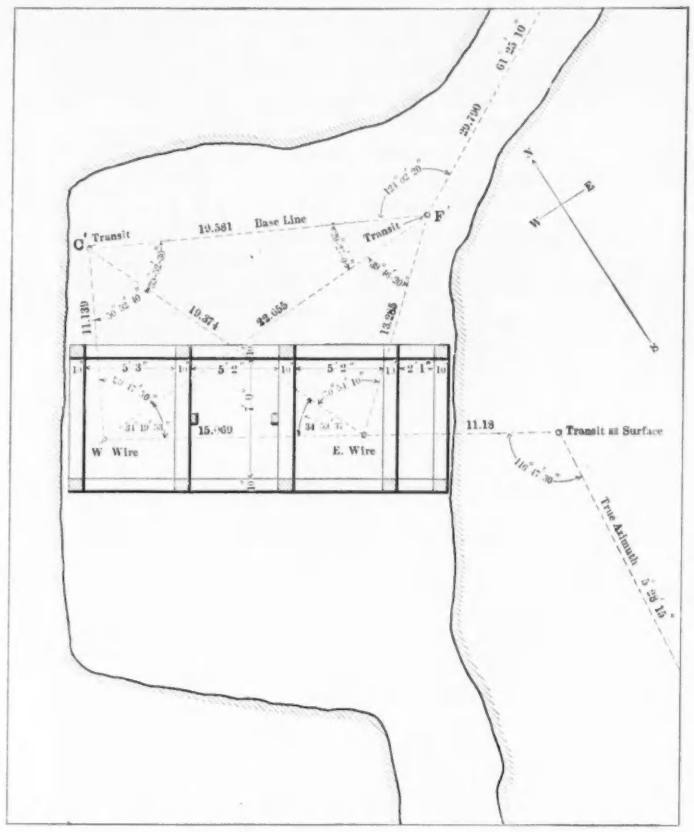


FIG. 2.—TRIANGULATION, 4,427 FEET BELOW SURFACE.

About the middle of January, the bronze wires were hung in No. 5 shaft as near as might be in the positions occupied by the steel ones in September. The distance between them at the top was 16.709 ft., while at the bottom the observations gave 16.850 ft., showing a divergence of 0.141 ft. This divergence it will be noted is greater than that observed in the case of the steel wires in September. We were now convinced that the behavior of the wires was to be explained by assuming that one or both of them were deflected from the normal position by the currents of air which circulated in the shaft. This suggestion of air currents had been made early in the work. It was treated with scant courtesy in the beginning, because it did not seem probable that the currents of air could be steady enough, both in volume and direction, to permit the constancy of mean position which had been observed. However, the hypothesis once admitted, it appeared that it might account for all of the observed phenomena. Desiring to make the proof as complete as possible, it was decided to hang the brone wires once more in No. 5 shaft, but this time to place the west wire in the compartment next the air shaft rather than in it.

It should be remarked here that during the sinking of this shaft, and until it is connected with some other portion of the mine, its ventilation is accomplished by dividing it into two parts by means of a tight casing between Compartments II. and III., Fig. 1. Compartments I. and II. form the so-called air shaft. An up-draft is induced in this air shaft, causing a down-cast in the other three compartments. At the time of the September and January plumbings there existed at different levels a number of openings in the casing. These openings permitted a rush of air from the down-cast side into the up-cast compartment. The effect of these currents of air would be to move the west wire toward the west. If these openings were closed off and the west wire hung in the compartment next the air shaft, No. III. of the figure, it seemed that the divergence would disappear, provided it were due to the assigned cause. They were hung in these positions on February 23, the east wire hanging as near as might be in the position occupied in September and January, the west one as near as might be in the center of the compartment next the air shaft. The positions are shown in the figure. Communication between the air shaft and the down-cast portion had been carefully stopped off as far down as the 29th level. Further, to prevent circulation as much as possible, the shaft was covered at the top as soon as the wires were in position. It was quickly evident that circulation could not be wholly stopped. There was yet a considerable convection current down close to the casing of the air shaft, and up in the two eastern compartments, the cause for this current being the difference in temperature between the top and the bottom of the shaft. Its distribution is explained by the fact that before the shaft was covered, the down-cast current was strongest close to the casing. As the covering failed to stop circulation, the strongest portion of the down-cast naturally maintained the position it already occupied. The measurements between the wires were, at top 11.944 ft., at bottom 11.962 ft., showing a divergence of 0.018 ft. This divergence was easily accounted for by the convection current above described.

The difference between the divergence of the steel wires in September, and of the bronze wires in January is readily accounted for by the fact that the circulation in the warm weather of September was much less vigorous than in January, and, further, that the steel wires afforded the smaller surface to be acted upon.

Consideration of the currents in No. 2 shaft, which is down-cast, accounts for both the divergence and the increased azimuth there observed. The small convergence observed in No. 4 may likewise be accounted for by the swirl of the currents as they enter this shaft, which is up-cast. Although an effort was made to stop these as far as possible during the actual observations, it was not practical to entirely cut them off. The contour of the walls of the plats above the 11th level in this shaft is such that the air currents from the cross-cuts hugging the outside of the curve will on actually entering the shaft have a tendency from the western wall toward the center, and this tendency will apparently be stronger close to the western wall than a little distance from it. Consequently, when the west bronze wire was moved away from this wall the wires hung more nearly parallel than when it was close to the wall.

It seems, therefore, that a very simple cause was at the bottom of the divergence which attracted so much attention. The remarkable fact is that the currents of air should be so constant in their action. When, however, the great depth of the shafts is considered, also the constancy for considerable periods of time of the temperature which may influence these currents, it seems after all reasonable that this steadiness should exist. The experiments have shown that the engineer who has before him the problem of plumbing a deep shaft has very considerable difficulties to overcome in the matter of the influence of the circulation of air in the shaft on his line. He should study this circulation very intently before deciding where to hang them, and in order to estimate the dependence that is to be placed on his results when the lines have been hung.

Synchronous Reactance.

BY F. G. BAUM.

IN using the "synchronous reactance" in calculating the regulating characteristics of a generator at different power factors we are, of course, replacing the demagnetizing effect and the effect due to self-induction by a single term. As I have not seen any method given to show the probable error due to using the synchronous reactance, one is here presented.

Suppose the generator to be running at normal speed. Short-circuit the armature and raise the excitation to such a value that full load current flows in the armature. Suppose the resistance pressure to be small in comparison with the total pressure. Let Ef (determined from the exciting current) be the number of volts to force *full load current* through the armature. Then if $L\omega$ is the synchronous reactance and I the current we have $L\omega I = Ef$. (Fig. 1). Let Ed be the number of volts corresponding to the demagnetizing ampere turns of the armature and the true e. m. f. of self-induction.

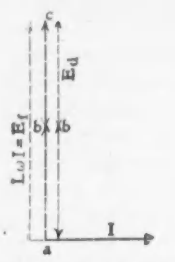


FIG. 1.—GENERATOR ON SHORT-CIRCUIT, RESISTANCE PRESSURE NEGLECTED.

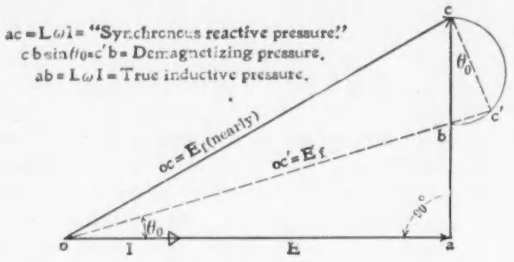


FIG. 2.—GENERATOR ON NON-INDUCTIVE LOAD.

The pressures Ed and ab are in opposition to Ef. Fig. 1 shows these relations.

Now suppose we connect the generator to an external non-inductive load and raise the excitation Ef so that we again have full load current in the armature, but with a pressure $E = Oa$ on the external load (Fig. 2). Let us assume that the reactive pressure ab remains the same (this will not be strictly true, because the reactance depends on the position of the armature coils with respect to the poles, and also upon the magnetic density). The demagnetizing effect is in direct opposition to the pressure developed. It can easily be shown that the magnitude of the demagnetizing effect varies practically as $I \sin \Theta_o$, Θ_o being the angle of lag of the armature current behind the developed pressure. If in Fig. 2 we draw a semi-circle on bc and draw the line ob and then project c on ob, we get $bc' = cb \sin \Theta_o$. The direction of the generator pressure is ob, and the generator must be excited for the value $E = oc'$. But oc' is practically equal to oc, since cc' is at right angles to oc'. That is, for a non-inductive load we may use the synchronous reactive pressure ac in place of the geometric sum of ab and bc'. Hence we may, for a non-inductive load, without appreciable error use the synchronous reactance in place of the true inductance and the demagnetizing effect. The angle between the current and the pressure developed is Θ_o; the angle we get by using the synchronous reactance is the angle between oa and oc.

If the current in the external circuit lags behind the pressure E by the angle Θ, then the line ac will rotate through the angle Θ, Fig. 3. bc' is again equal to the demagnetizing effect $I \sin \Theta_o$, and $oc' = Ef$. But oc' is again practically equal to oc.

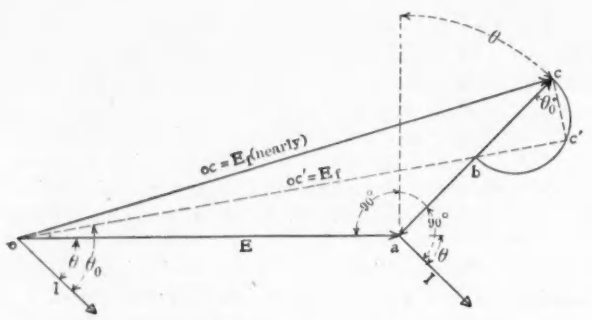


FIG. 3.—GENERATOR ON INDUCTIVE LOAD.

If the current in the external circuit leads the pressure E by the angle Θ, then the line ac will rotate in the opposite direction from the vertical through the angle Θ, Fig. 4. The demagnetizing pressure $bc \sin \Theta_o$ has reversed, and the armature ampere-turns are now acting to magnetize the generator. The pressure corresponding to the magnetizing effect is bc'. The pressure developed is $oc' = Ef$. But again we see from the figure that oc and oc' are practically equal.

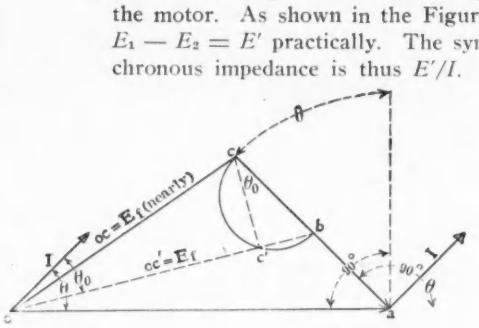


FIG. 4.—GENERATOR ON CAPACITY LOAD.

Thus we see that, so far as the determination of regulation of the generator is concerned, we may use the synchronous reactance without appreciable error. If we do not neglect the armature resistance, the conclusion we come to is the same, since the pressure to overcome the synchronous reactance is large in comparison with the resistance pressure.

The synchronous reactance is usually determined from the short-circuit current of the generator. This determines the synchronous reactance with a weak field or abnormal armature current, and will usually give a value larger than that corresponding to the working pressure and current. The following is a method which is believed to have some advantage over the usual method:

Run the generator as a synchronous motor, but with no load. Set the excitation for a normal working value. Now raise the excitation applied to the motor, until one-half to full-load current flows in the motor (too large a current in the armature may distort the e. m. f. wave developed, which may produce hunting. If the distorting effect is small and no hunting is produced full load current may be drawn). Since the motor is running at no load with large armature current, the pressure applied and the pressure developed by the motor will be practically in opposition, as shown in Fig. 5. E_1 is the pressure applied to the motor, E_2 is the pressure developed by the motor, and E' is the resultant pressure forcing the current through the motor. As shown in the Figure, $E_1 - E_2 = E'$ practically. The synchronous impedance is thus E'/I.

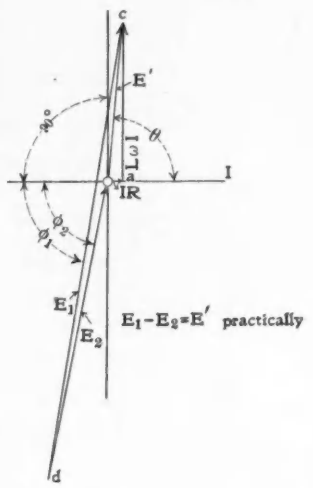


FIG. 5.—DETERMINATION OF SYNCHRONOUS REACTANCE.

In Fig. 5, $R\,I$ is the resistance pressure and $L\,\omega\,I$ the synchronous reactive pressure. The angle Θ is usually nearly 90°, and since there is no load on the motor the angle ϕ_2 will be nearly 90° also. Hence, E', E_2 and E_1 are nearly in the same line. The synchronous reactance is

$$L\omega = \sqrt{\left(\frac{E'}{I}\right)^2 - R^2}$$

By this method we get the synchronous reactance when the machine is developing normal pressure and, hence, should give more accurate results than is obtained by short-circuiting the armature, because by the latter method we have either weak fields or abnormal armature current.

Fanning Island.

Material for cable structures on Fanning Island is now, it is said, being bought in San Francisco. A cable station is to be established there in the line of the British Pacific cable. On it the Pacific Cable Board will expend $120,000. The plans provide for quarters for the telegraphic staff, including an operating room, a dwelling for the superintendent of the station, a carpenter shop, bath houses, a lamp room, kitchens, and a large reservoir for catching and preserving rain water for drinking purposes. The walls of these structures are to be of coral obtained on the island, but all the other material will come from San Francisco. The cable station will be located at English Harbor, the only shipping entrance on the island.

A British Refuse Lighting Plant.

FROM time to time we have noted in our columns the construction in Great Britain of refuse incineration plants, or "Dust Destructors," in connection with electric light stations. According to a recent list of British central stations, 15 of these are supplied with destructor plants, and of stations now under construction, three will be similarly equipped. In some cases the destructor plant is merely an auxiliary service, while in other cases it furnishes the principal source of heat for raising steam. Among the latter class is a plant recently built in the suburbs of Glasgow, to supply the Burgh of Partick, of which we give below a description.

As will be seen by reference to the accompanying ground-plan (Fig. 2) there are two main buildings and a smaller building for offices. The destructor house has its own fan and pump house, with stores, coal store, etc., and although adjoining, is kept distinct from the electrical portion of the station. The engine-room is 55 ft. x 40 ft. x 25 ft. high to the roof principals, and is served by a 10-ton crane. The room is well lighted from the roof, and the north wall is temporary, for although there is still space inside the present engine house for considerable extensions, plenty of room has also been arranged for extending the buildings.

The destructor house is 88 ft. x 62 ft. x 24 ft. from clinkering floor to roof principals. The chimney is 153 ft. high, and is lined with firebrick throughout, an air-space of 2 in. being left between the fire-brick and ordinary brick in the chimney and in the main flues. The chimney is surrounded at the base with a dust-separating chamber, and it is built on a block of concrete, 36 ft. x 36 ft. x 6 ft. deep, in the bottom of which is buried a raft of steel girders placed across each other at right angles and bolted together. There are in all some 54 girders, 36 ft. x 6 in. x 5 in. x 24½ lbs. in this raft.

The destructor consists of three "units," each composed of a water-tube boiler and two cells—*i. e.*, six cells and three boilers in all. Each cell is capable of consuming 10 tons of refuse per day, with a forced draught equal to a head of 3 in. of water. There is, besides, a fourth boiler, which is arranged for coal firing only. The four boilers each have a heating surface of 2,010 sq. ft., with a grate area of 39 sq. ft. Each is provided with dead weight safety valves and high-steam and low-water alarms. The three boilers included in the

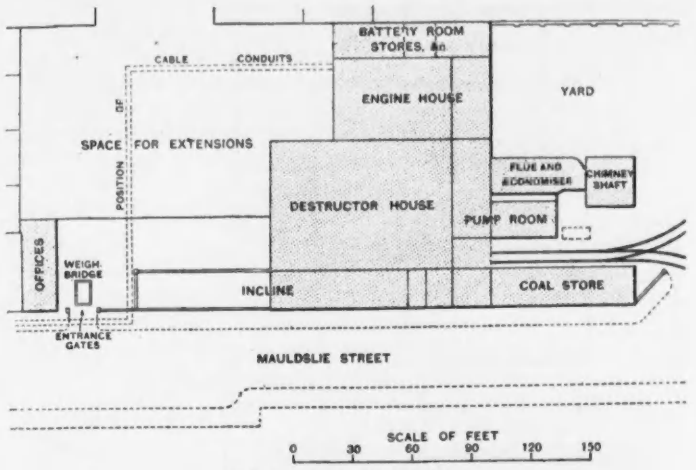


FIG. 2.—GROUND PLAN.

destructor proper have a cell on either side of them, with dampers in the side walls just over the ordinary coal grate, so that the boilers can be fired by coal or refuse or the two together. It is, however, not intended to adopt the last alternative, and it is expected that coal will only require to be used on exceptional occasions, such as on Sundays, when there is no refuse to burn. Each boiler and cell is provided with forced blast by two fans driven by single-cylinder enclosed engines, capable of delivering about 8,000 cu. ft. of air per minute under a head of 3 in. of water. The draught is regulated by a valve on each cell and boiler, the air duct being carried

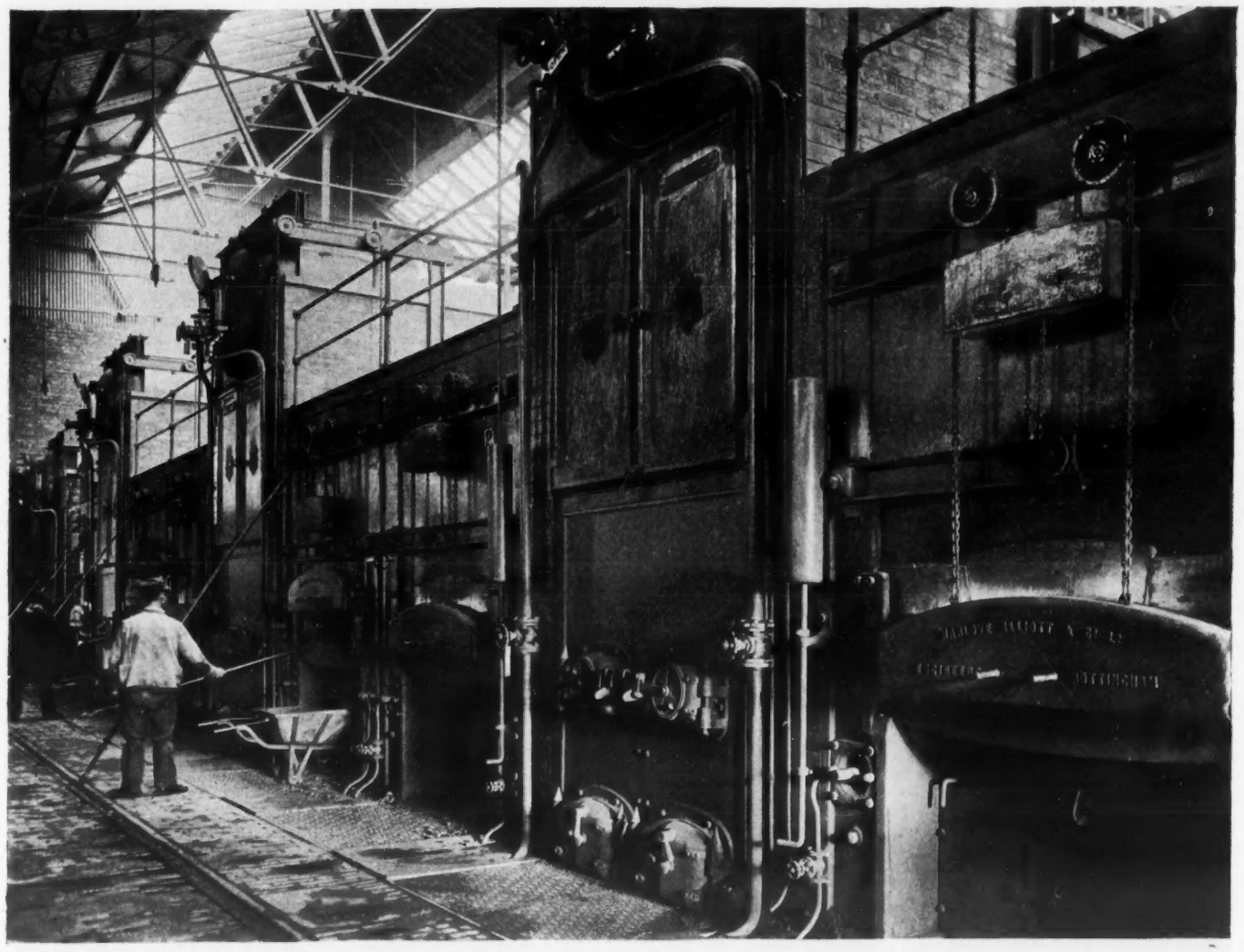


FIG. 1.—THE DESTRUCTORS, BURGH OF PARTICK PLANT.

right under the boiler. There is also a third fan and engine, exactly similar, for a stand-by in case of accident. A steam jet apparatus is also provided for each cell.

The feed pumps are two in number, and are capable of delivering

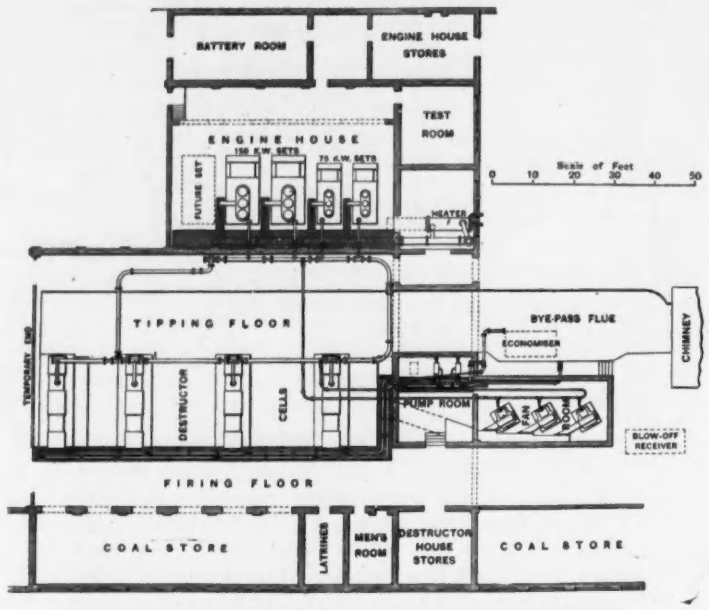


FIG. 3.—PLAN OF GENERATING STATION AND DESTRUCTOR.

1,700 to 2,700 gallons of water per minute respectively. The feed pipes are in duplicate, each boiler being independently connected to each range. The feed water is taken from the Glasgow Corporation mains, a storage tank of 10,000 gallons capacity being provided in case of failure of the supply. This storage tank has a heating coil placed in it, through which the pumps and fan engines exhaust, and in addition to this the exhaust from the main engines passes through a feed-water heater. Owing to the cost of the town water supply and the expense of arranging for any other supply of water, condensing has been dispensed with at the outset.

The steam piping is in the form of a ring main, placed wholly in the boiler room, branches being led through the wall to each engine. The steam pipes are of mild steel, and the steam valves have cast-steel bodies. The exhaust and feed-pipes are of cast iron.

The generating plant at present consists of two 150-kw and two 75-kw Belliss-Peebles generating units. The two smaller ones are of the two-crank, two-cylinder enclosed compound type, running at 500 r. p. m., while the two larger ones are of this firm's latest pattern of three-crank, three-cylinder, triple-expansion design, with cranks at angles of 120 degrees. The cylinders are fitted with piston slide valves, and are designed to be self-draining. Oil is supplied to all bearings by means of a simple form of pump, without valves or packing, discharging at a pressure of 10.20 lb. per sq. in. through a specially arranged system of oil channels. The oil escaping from the bearings drains into a crank pit, to be used over again.

The dynamos are of the standard four-pole type, shunt-wound, generating at a pressure of 480 to 520 volts. The balancer consists of two 15-kw machines coupled together, and the booster of two 15-kw dynamos on the same shaft with a 30-kw motor, the motor being placed in the center. All the machines are four-pole machines, shunt wound, and the four 15-kw machines being all the same size reduces the number of spare parts to a minimum. The booster generators are provided with reversible switches in circuit with the shunts.

A double battery is installed, consisting of 284 Tudor cells, capable of discharging at 75 amperes for eight hours, or 180 amperes for three hours. The battery-room measures 33 ft. 6½ in. x 16 ft. 6½ in., and the cells are arranged one-half on the floor and the other half supported on steel girders, carried from wall to wall, giving some 7 ft. clear headroom, a gangway being arranged all round the upper tier for inspection. This is a far better and more convenient arrangement than the usual method of two-tiered stands. The lugs of the plates are all burnt up together, and the cells are mounted on oil insulators, while the stands themselves are further mounted on large oil insulators. A booster is provided for "bringing up" separate cells if necessary.

The main switchboard is fixed on a high gallery and is of enamelled slate with T-iron framework. The generator panels consist of four slate tablets, two positive and two negative, the two 75-kw generators being connected to one pair of panels, and the two 150-kw generators being connected to the other pair. All four

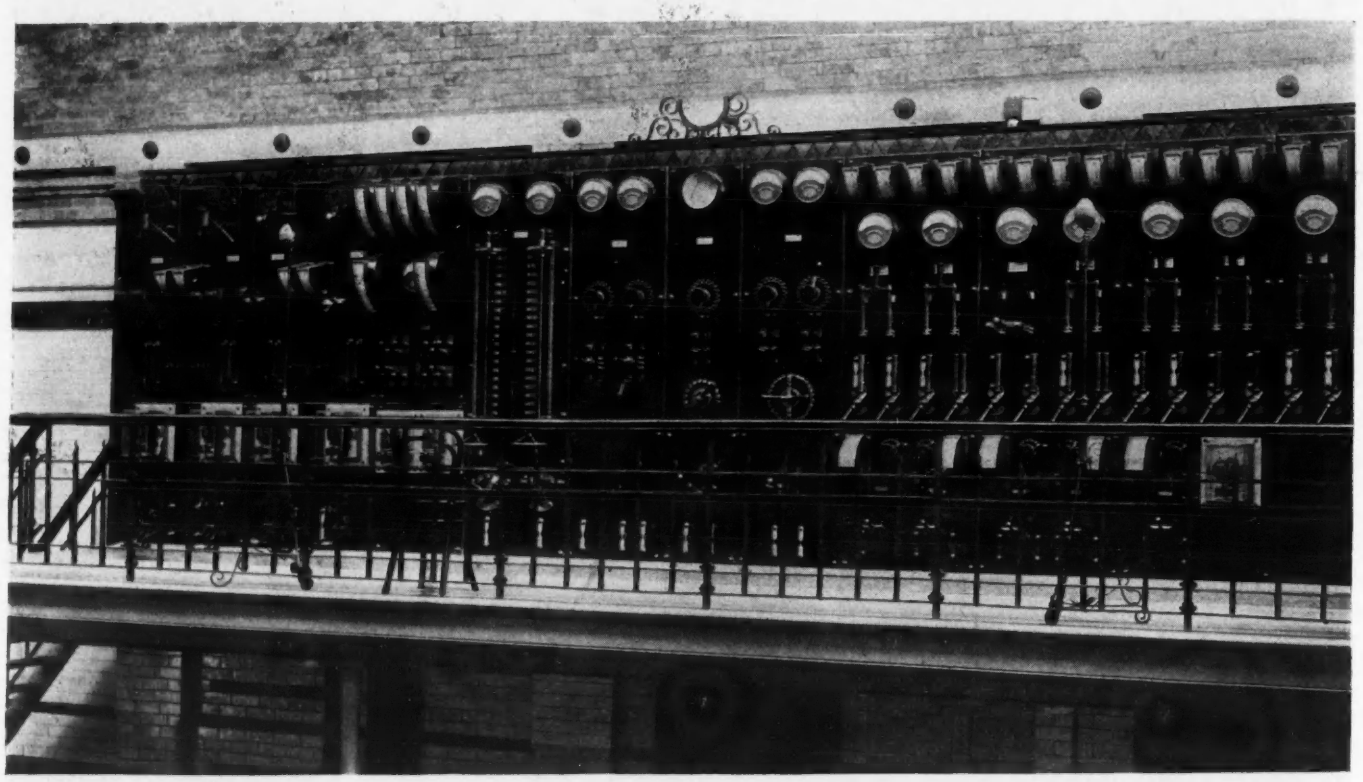


FIG. 4.—MAIN SWITCHBOARD, BURGH OF PARTICK PLANT.

circuits are similar, and consist on one pole of an automatic cut-out and watt-hour meter; on the other pole are 160- and 350-ampere main switches and fuses and circuit breakers, together with field regulating and breaking switches. The next panels are devoted to measuring purposes, on the upper panel there being six edgewise Kelvin voltmeters and a polarized ammeter and short-circuiting and isolating plugs; the lower panel contains at present

simply two watt-hour meters. The battery panel comes next; the upper tablet contains the two battery regulators and main switches and two 200-ampere ammeters; the lower tablet contains the two battery and booster switches and fuses.

On the booster panel, which is next, the upper tablet contains two 150-ampere ammeters, and also the two field break and reversing switches and field regulators; the lower panel contains only the four fuses. The booster motor panel has on the top tablet a 75-ampere ammeter, shunt regulator, and breaking switch and main regulators, while on the bottom tablet there is a main switch and two fuses. The balancer panel has two 50-ampere ammeters, two field regulators and breaking switches, and a main regulator, the bottom tablet having a main switch and two fuses. The next four panels are the feeder panels, each panel having the fittings of two feeders on it; the fittings for each feeder are as follows: Two edgewise ammeters, a voltmeter, and double-pole main switch and duplex fuses on each pole, with change-over switch on each. The fuses are covered with mica shields to retain the melted fuse metal when it "blows." On the lower tablets are placed the controlling gear for the arc circuits, consisting of an edgewise ammeter, double-pole switch regulating resistance and plug substitutional resistances, each equivalent to one lamp. The switches are of the double-bladed knife type.

The distributors and feeders are all triple concentric and lead-covered. The feeder cables are drawn into Doulton conduits, but the distributor cables are laid on the solid system in earthenware troughs filled in with pitch. There are six feeders laid from the generating station to different parts of the town, as follows:

	Square in.
No. 1 to corner of Dumbarton Road and Byres Road..	0.2, 0.16, 0.2
No. 2 to corner of University Avenue and Byres Road.	0.3, 0.2, 0.3
No. 3 to corner of Minard Road and Hyndland Road..	0.2, 0.16, 0.2
No. 4 to corner of Hamilton Terrace.....	0.1, 0.06, 0.1
No. 5 to corner of Gordon Street.....	0.2, 0.16, 0.2
No. 6 to corner of Maudslie Street.....	0.1, 0.06, 0.1

The feeders terminate in a feeder pillar instead of the ordinary manhole. Provision is made in each pillar for one feeder and six distributors. Two porcelain fuse switches are provided for each main, and all the neutrals are fixed direct to a common bus-bar. All the fittings are mounted on two enamelled slate tablets. A useful adjunct is provided in a demand indicator, and arrangements are made enabling this to be plugged into any of the mains, which give a useful means of determining the distribution of the load over the system. The feeder pillars have doors both back and front, and where they do not block the foot-paths there can be no doubt of their greater conveniences than manholes. The total length of feeders laid amounts to about 6 miles.

All the distributors are 0.1 by 0.1 by 00.6 sq. in. in section. Disconnecting boxes are provided at all street corners, and it is intended to use fused disconnecting boxes at all important junctions. The total length of distributors laid at present amounts to about eight miles. Besides this there are some four miles of arc cables.

The public street lighting consists of 47 12½-ampere double-carbon arc lamps of extra long type. Substitutional resistances are not provided for each lamp, but the circuits are run back to the engine room, where resistances are provided, which can be put into circuit should any of the lamps cut themselves out; an equivalent resistance to three lamps is available. In all the lamp pillar bases an automatic switch is fitted, which at midnight cuts out the arc lamps and switches on two incandescent lamps of 25 cp each, placed on brackets on each pillar. In the majority of cases the arc and incandescent lamp fittings are carried on the tramway poles, but in places where the trolley wire is carried from rosettes attached to the buildings, independent poles are provided.

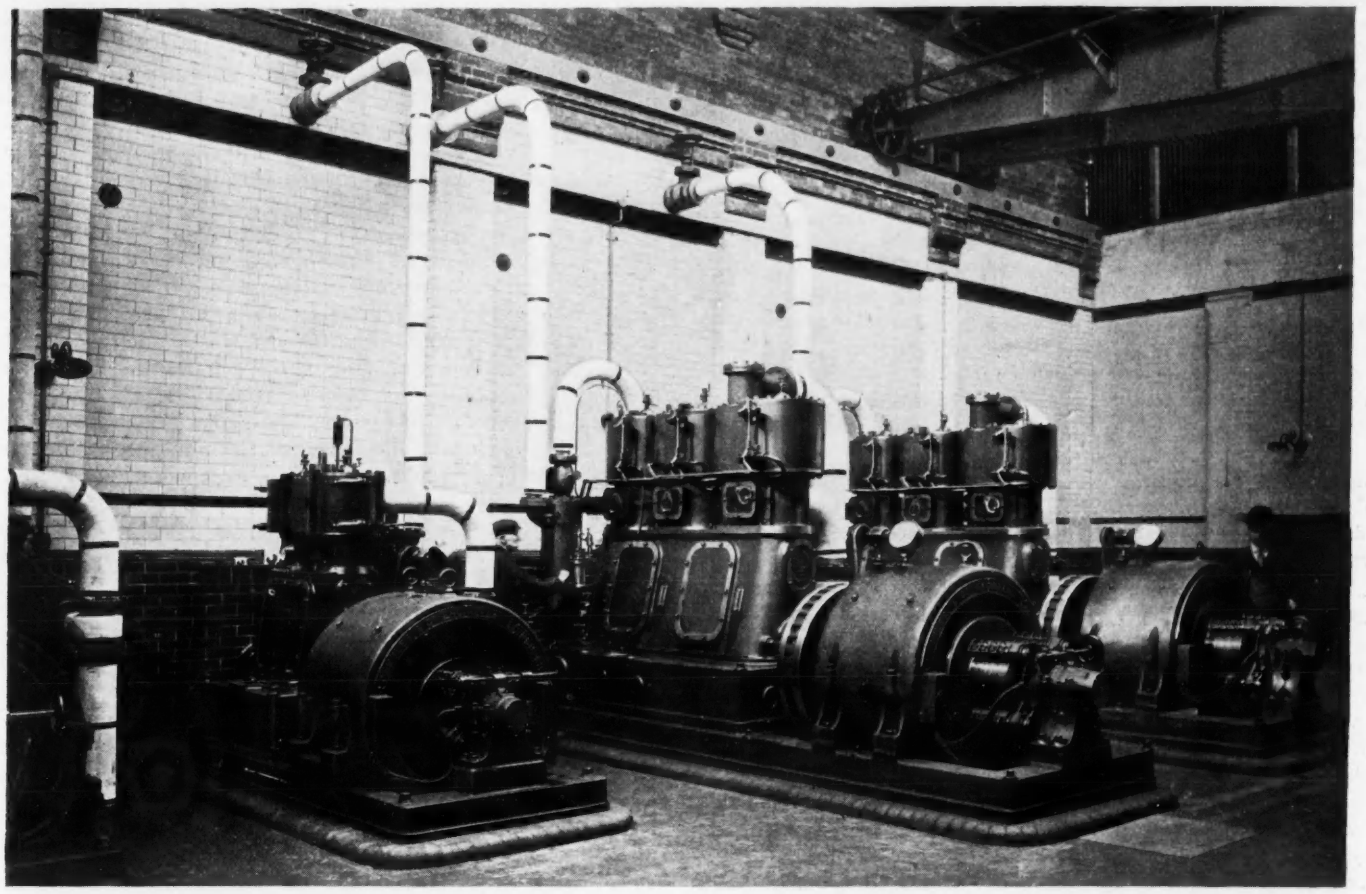


Fig. 5.—Generating Room, Burgh of Partick Plant.

Up to the present, some 7,000 8-cp lamps have been applied for, besides the street lamps. Two workshops are also taking 85-hp for motors. There seems a probability of this load being more than doubled before next winter, as a number of prospective consumers will not wire till the summer clearing is being done. One circumstance which has been very much in favor of the undertaking starting with so satisfactory a load is due to the fact that for a year or more past, portions of the residential district have been supplied with current purchased in bulk from the Glasgow Corporation, whose mains adjoin.

The total cost of the combined buildings and plant is about $325,000—$250,000 for the electricity works and $75,000 for the destructor. Soon after the contracts for the various works were fixed, the council appointed Mr. H. B. Maxwell as the residential electrical engineer, under whose personal supervision the entire work has been carried out.

Cost of Construction and Maintenance of Telephone Plants.

At the recent independent telephone convention, in Chicago, Dr. H. I. Kerr, of Ottumwa, Ia., read a paper, giving some much-needed data on the cost, construction and maintenance of telephone plants.

The cost of a telephone plant can, he said, be quickly estimated approximately, at the present prices of material and labor, on a basis of the number of instruments installed. For example, an exchange of 500 stations installed within a radius of one or one and a half miles and no conduit or cable work, but up-to-date construction, will cost approximately $65 a station, or $32,500; this will come so near to the real cost that a company can base its calculations on it with a degree of certainty. As the number of stations increases, the radius or distance from the exchange will also increase, and therefore, the cost. In estimating on one thousand stations installed, we must take into consideration some aerial cable, and more substantial construction and much more costly equipment, and therefore there would be a material increase in the cost per station. Without conduit work, a safe approximate would be $85 per telephone.

Where the demand for telephones exceeds one thousand, and quick, up-to-date service is required, it is absolutely necessary to be equipped with central energy and multiple switchboards, and when in towns where electric light and electric street cars are used, requiring many additional appliances to overcome the interference caused by them, and where it is necessary to construct conduits, we cannot with safety calculate less than $100 per station installed; that is, 1,000 stations under such conditions would cost to install, approximately, $100,000. These prices are only approximate, and may vary 10 or 15 per cent., according to local conditions. In large cities where 5,000 to 10,000 subscribers are connected, the cost will approximate from $150 to $200 per station installed.

Very few who are engaged in the independent telephone business knew the expense of operating or the cost of maintenance approximately, when they entered into the business; much less did they consider that the expenses increased, not only approximately to the number of subscribers, but in an arithmetic progression. To explain, the expense of operating an exchange of 1,000 subscribers is much more than twice the expense connected with an exchange of 500. At first thought we naturally say that if you can give service to 500 subscribers at $1 per month, you can give service to 1,000 for less. Practice proves just the reverse. The reasons why are many, some of which may be plainly understood from the following:

When there are 500 subscribers connected with an exchange, each subscriber can call up 500 others, and by the time every subscriber calls up every other subscriber there are sent through the exchange 250,000 calls; when there are 1,000 subscribers and every subscriber calls up every other subscriber once, there are not only twice as many calls sent through the exchanges as there were when only the 500 were on the board, but four times as many, making 1,000,000 calls, which is the ratio in increase of the use of the telephone with the increase of subscribers. This requires four times as much labor to take care of one thousand subscribers as to take care of five hundred, four times as much wear and tear on the apparatus, and much more central machinery or apparatus to do it with.

The same is true of outside construction. Consider that the first 500 subscribers are within a radius of one mile from the exchange, with an average of one-half mile of pole lines, and in full metallic circuit, it means one-half mile of wire out and one-half mile in; the second 500 come within a radius of two miles from the exchange, making an average distance of one and one-half miles for poles and wires, or three half miles out, and three half miles in, making the amount of construction to reach the outer 500 three times that of the first 500, and four times that required to serve the first 500 will be required to give service to 1,000.

I doubt whether this covers it all when we consider the amount of territory that must be covered by poles and wires as the circle increases. The territory to be covered in a radius of one mile is only a fraction less than four square miles. The territory covered in a radius of two miles is four times that, or 16 square miles, requiring 12 square miles to be covered with poles and wires to serve the second 500, which added to the cost of the first 500 would make three times as much pole cost to serve 1,000 subscribers as it requires to serve 500. To serve the out-districts the wires can pass over the poles of the first districts, but the poles will have to be much larger and cost more. The amount of cross-arms and wire and insulators is the same as if all the wires were put on separate poles from the central office out.

There appears to be a general impression among those who think but once that after a telephone line or telephone system is built the work is done for all time. But that is not the case. Decay and trouble begin as soon as the poles are set. The average life of the white cedar poles as we get them to-day is from 15 to 20 years. Galvanized iron wire in towns and cities cannot be counted on for a period much beyond six or seven years. In the country this is much longer. The life of a switchboard is from 15 to 25 years, owing to the constant repairing and replacing of parts giving out or wearing out as time goes on. Telephones have been an uncertain quantity till within a few years. There are a few telephones that have been used many years, proving that durable, efficient telephones can be made. But there are many that have been thrown away in a very few years, which is in accord with poor construction in everything. The best is what we want.

The expense of maintenance when good up-to-date appliances are used, with the very best of construction, should not and does not exceed three per cent. to five per cent., so that we are on the safe side of our investment when we make a five per cent maintenance fund and a six per cent. dividend. As we have already stated, the cost of maintenance increases much more rapidly than the number of subscribers. This is being understood by many and is evidenced by the franchises granted in different cities, containing a clause granting the privilege to increase rate for telephone service as the number of subscribers increase.

By examining the Bell rates of 1889 or 1890, and comparing them with the actual condition and experience of the independent people, Dr. Kerr has come to the conclusion that the rate should have been established at about three-fifths of that of the Bell companies, all things being equal, which would give a bare remuneration on capital invested. It would not have been a "get-rich-quick" business, but a clean investment, and justice would have been done to all.

The independent people have reduced the rate of telephone service, and by so doing the telephone has come into general use and become a public necessity in place of a public luxury. True, it has cost much money, but the independent companies have this faith in the people, that they will stand by the company that has served them best.

British Telegraph Operators.

Some of the telegraph operators in this country have an idea that government ownership would bring the millenium for them. The following special cable dispatch to the New York *Sun*, of April 19, may enlighten them on the subject: The House of Commons was occupied for several hours last evening in discussing the grievances of post office and telegraph employes. When a vote was taken the government escaped defeat by a majority of only 31 votes. There are well-founded complaints that pressure was brought by the organized civil servants upon members of Parliament, and on the other side there are dark threats of disfranchising every one in the government service. But these charges are really made to obscure the issue; for it is beyond doubt that the lower grades in all sections of the British civil service are scandalously underpaid.

A few years ago, for instance, the Controller of Telegraphs in London, Sir Henry Fisher, in giving evidence before a committee of inquiry, declared that the junior telegraph operators were not paid enough to live upon. Yet nothing has been done since to remedy such a shameful state of things. This system of official sweating has driven the telegraph operators and other post office employes to organize for the redress of their grievances, and there are now five trade unions in that government department with an aggregate membership of 50,000. One of these days there may be a great strike which will paralyze the business of the country.

The humbler employes in other departments of the state service are all underpaid. There has been formed this week an association styled the Civil Service Writers' Guild, the sole object of which is to obtain for members work after office hours, which will enable them to supplement their meagre official pay so that they may live in something approaching comfort. Inadequate pay is not their only grievance. Favoritism is rampart in every department of the public service.

The Reception to Lord and Lady Kelvin.

The reception to Lord and Lady Kelvin, planned by the American Institute of Electrical Engineers, was given with great success at Columbia University, in the gymnasium, on the evening of Monday, April 21. The distinguished guests arrived on the preceding Saturday, and having received, while still at sea, by means of the wireless telegraph, an invitation to attend the exercises at Columbia, proceeded thither almost immediately after landing, and were prominent among those who participated in the inauguration of President Butler. During the forepart of Monday, Lord Kelvin took part also in the proceedings at the university of the American Physical Society, then holding its annual meeting, and he and Lady Kelvin were afterwards entertained by Prof. Crocker, Dr. Pupin, Prof. Sever and Prof. Townsend, of the electrical engineering department. They were very much pleased and delighted to notice the evidences of growth which characterized the university since they last visited it some four or five years ago.

As has already been mentioned in these columns, the reception was held at Columbia in order to secure a hall that would be large enough for the purpose, and because the authorities were desirous of showing special honor to the leading scientist of Europe, who, while wonderfully hale and hearty, may not be able to stand the fatigues of another trip across the Atlantic. Finding that other societies were desirous of extending hospitalities to Lord Kelvin, and as the time of the visit in this country is very short, the Institute invited to co-operate with it the American Physical Society, the American Association for the Advancement of Science, the American Mathematical Society, the Astronomical and Astrophysical Society of America, and the New York Academy of Sciences. Other bodies were anxious to join, but in view of the large membership thus covered it was deemed pertinent to go no further. The Committee on Arrangements consisted of Dr. F. B. Crocker, chairman; Mr. C. W. Rice, secretary; Dr. R. S. Woodward, Mr. F. P. Keppel, Secretary of the University; Dr. A. G. Webster, Prof. James McA. Cattell and Mr. T. C. Martin. To the chairman and the secretary great credit is due for the large amount of thought and work put upon the affair, and for the success which attended their efforts; and special praise is due to Prof. Crocker, who is by no means in the best of health, but assumed cheerfully the burdens of the work and represented both the Institute and the University most admirably.

The proceedings in the gymnasium began at 8:30, and the special addresses were timed for 9:30, in order to give the audience opportunity to assemble and to get into its seats before the speaking began. An excellent band of music was provided, and a very pleasant hour was spent; the gymnasium answering its purpose excellently, being very cool and comfortable in spite of the fact that all the lights were going brilliantly and that nearly 2,500 people were assembled within its walls. The auditorium and the platform were handsomely draped with the Columbia colors of light blue and white, while trophies of flags and other decorations were suspended around the semicircle facing the stage. Nearly 2,000 seats were in readiness on the floor, while some 400 were reserved on the deep platform for the officers and committee members of the various co-operating bodies. Back of the platform again was a large foyer, looking out on the house, which served as a social rendezvous and as a means of communication between the two sides of the house.

The gathering of notables was remarkable, and it would take a full page of this paper merely to enumerate the well-known men present prominent in the various branches of art and science. The American Institute of Electrical Engineers was out in force, the members feeling that the credit of the affair would be largely theirs, and desiring to do honor to one whose work has gone so far to create the arts with which they are connected. Among those present may be named: Messrs. T. A. Edison, Nikola Tesla, George Westinghouse, Frank J. Sprague, C. S. Bradley, S. S. Wheeler, C. Batchelor, P. B. Delany, W. J. Hammer, J. W. Lieb, T. E. Murray, N. F. Brady, F. B. Hertzog, C. F. Scott, R. T. Lozier, C. P. Poole, C. T. Child, W. S. Andrews, J. M. Wakeman, F. R. Upton, W. S. Mallory, Luther Stieringer, Prof. R. B. Owens, of Montreal; E. H. Mullin, J. Sachs, John Bottomley, W. F. Willcox, R. W. Pope, T. Wolcott, G. S. Dunn, R. D. Mershon, C. A. Terry, M. I. Pupin, F. Townsend, G. F. Sever, C. E. Knox, Wm. Maver, T. R. Taltavall, E. D. Adams, Sir P. Sanderson, British Consul-General.

Shortly after half-past nine Prof. Crocker escorted Lord Kelvin to the platform amid salvos of applause, and Mrs. A. G. Webster, who sat next to her, presented Lady Kelvin with a handsome bouquet of white roses tied with streamers of light blue silk ribbon, a graceful little act which elicited warm approval from the audience.

Dr. Crocker, as chairman of the committee of arrangements, then announced the purpose of the gathering, paid a handsome eulogy to Lord Kelvin, and introduced Dr. Nicholas Murray Butler, to make the address of welcome as president of Columbia University.

Dr. Butler was enthusiastically applauded as he arose. He said that he was proud to share with the American deans and living masters of science the honor of welcoming one of Great Britain's greatest teachers and inventors. Lord Kelvin, he said, had not only gone out to more points in the unknown than most men, living or dead, but had made his information practical and easily understood. Dr. Butler elicited warm applause by remarking that such incidents were among the strong bonds tending to unite more closely America and the Mother Country.

Prof. Elihu Thomson, on behalf of the American Institute of Electrical Engineers, was the next speaker, and delivered its welcome with all his wonted felicity and grace of expression. He rehearsed the career of Lord Kelvin, dwelling upon each of his achievements in the electrical field and pointing out that the genius which began with the submarine cable was still busy creating new apparatus and elucidating new ideas and principles in electricity and physics. Prof. Thomson, referring to a cable episode as being according to his boyish recollections in 1866. Lord Kelvin jumped up like a flash and said it was 1865. This instantaneous evidence of mental alertness and keeness of memory brought down the house, while Prof. Thomson scored neatly also by saying that while correction at Lord Kelvin's hands was always a pleasure, he welcomed it now because it made him one year younger.

Dr. Arthur Gordon Webster followed, on behalf of the American Physical Society, of which he is vice-president, and gave one of the best speeches of the evening, making some good points as to the relations of the physicist and engineer, and dwelling upon Lord Kelvin's work as a physicist. He was followed by Dr. R. S. Wood ward, past-president of the American Association for the Advance ment of Science, who spoke for that body and the remaining ones that had joined in the reception. Three rousing cheers were then given for Lord Kelvin, who with great vigor and animation, spoke for about half an hour, dwelling upon his earlier work and paying a warm tribute to the memory of Cyrus W. Field.

"Science," he said, "has advanced greatly during recent years among all lines, and one of the greatest achievements is that of Marconi and wireless telegraphy. It is a great achievement to send a message inland from 100 miles out at sea, or for several hundred miles. The work that he has done indicates that the time will come when messages will be sped over the ocean without an intervening wire. But, my friends, we must not forget the great achievement which gave us submarine telegraphy, which will continue to serve us well, even with wireless telegraphy as a commercial success.

"As I said before, Americans of all others, must not forget the work of Cyrus W. Field. I always got inspiration from the time I first came to America. The first time I landed on this continent was in 1866, and my landing was in Newfoundland. One might not believe it, but I got wonderful inspiration from Newfoundland. Ten years later I came over to your Centennial Exposition, and America had given to the world then a triumph of science in the telephone. I got inspiration on that visit from meeting and talking with Alexander Graham Bell.

"The next time I came was in 1884, and then I found the great achievement of Edison perfected and New York as bright by night as by day through his invention."

There was great applause at the mention of Mr. Edison's name, and he was at last compelled to rise and bow.

Lord Kelvin spoke finally of the inventions which made possible the transmission of power at high voltage and the harnessing of Niagara. Of this he said: "Beautiful as is that wonderful work of nature, it would be more beautiful still if those waters fell upon turbine wheels every one of which was turning the wheels of industry." He then referred in terms of high praise to the recent work done in California in transmitting current in large volume at high pressures over 220 miles, lauding the men and methods that rendered such a thing feasible; and he recalled the predictions he had made

some years ago as to the possibility of such work at 300 miles and more.

The stated exercises, which lasted about one hour, were brought to a fitting close by three tremendous rounds of cheering for Lord Kelvin, and the band then resumed its programme. In view of the large attendance it had been deemed by the University authorities inadvisable to attempt to serve any collation, as the audience would have had to leave the gymnasium and proceed to another part of the University and then return to secure hats and coats—a formidable undertaking in view of the fact that there were nearly a thousand ladies and more than fifteen hundred men present. It was also deemed, for much the same reason, inadvisable to attempt a regular presentation to the guests of the evening, but many of the audience were not to be denied, and as soon as the proceedings were over they took the big platform by assault, and for some 15 to 20 minutes Lord and Lady Kelvin were the somewhat helpless occupants of the center of a human maelstrom. They extricated themselves from this crush good-naturedly, and about 11 o'clock were driven back to the Waldorf-Astoria, one of the handsomest electric coupés in New York City having been retained for their service during the evening by the New York Transportation Company. The whole affair marked a red-letter night in the annals of the Institute, and will be long remembered by those who had the honor and pleasure of participation.

The Dutch-German Cables.

It has just transpired, according to the New York *Times*, that a secret protocol was entered into between Germany and Holland shortly after the Spanish-American war, with a view to maintain the strict neutrality of cable lines in time of war. The presence of the protocol became evident owing to the wording of a bill recently presented by the Dutch Government before the States General. The main features of the bill furnish the two signatory powers with the requisite authority to establish a new telegraphic communication between Germany and Holland, on the one hand, and their Atlantic possessions on the other, by means of cables, which shall be under the joint control of the two powers and independent of the British cable companies concerned. It is proposed to accomplish this end by the formation of a German-Dutch Cable Company, the seat of which will probably be at Cologne. This cable company is to obtain the exclusive concession for laying telegraph cables from Menado, the chief place of Northern Celebes, to the Island of Guam, belonging to the group of the Marianas, now in the possession of Germany, and from Guam to Shanghai. At Guam these cables will connect with the American Pacific cable between San Francisco and the Philippines. The Dutch Government having undertaken to lay a cable between Menado and Balik Papan, in Borneo, where a telegraphic communication already exists with Java, the result of the whole scheme, when completed, will be the establishment of an independent German-Dutch cable communication with the colonies of the two States in Asia, and with China, by way of San Francisco.

The German-Dutch Cable Company to be formed at Cologne, with articles of association to be approved by the Governments of the two States, will receive during a period of at most twenty years, an annual subsidy, which, in the case of Germany, will amount to about $250,000, and in the case of the Netherlands to about $70,000. But up to 90 per cent. of the receipts of the company will be used for the purpose of reducing the annual subventions. The joint control of the two powers will be exercised by an international directorate, one-quarter of the directors being German subjects and as many again Dutch subjects.

Just how the secret protocol which is added to the treaty may enforce the neutrality of the cables, may only be guessed at, for, it is added, in regard to the treaty, that in case of disputes concerning its interpretation, the signatory powers agree to invoke and abide by the decision of the International Court of Arbitration at The Hague.

German Storage Battery Syndicate.

A special dispatch from Berlin states that the Storage Battery Syndicate has been dissolved and that the prices of storage batteries have been reduced from 10 to 20 per cent.

Electric Traction for Swiss Railways.

Mr. Henry M. Morgan, U. S. Consul at Aaran, Switzerland, sends the following data as to the operation of all the Swiss railroads by electricity:

Two months ago, an interesting study was published by L. Thormann, a Zurich engineer, on the possibilities of substituting electricity for steam on the Swiss railways. The idea itself is not a new one, but it has never received such expert investigation. The fact that Switzerland is dependent on foreign countries for all the coal she consumes—not an ounce thereof being produced in the country—has drawn attention to the great unemployed water power, and has given rise to many propostions tending to promote the country's independence in traffic and industry. It is also not entirely beyond the limits of possibility that some of the coal-producing countries from which Switzerland draws her supply may pass laws prohibiting the export of coal, and thus force her to buy at ruinous prices. Engineer Thormann proves that it is quite possible to raise sufficient water power to operate all the Swiss railways, but at the same time he shows that it is a mistake to believe that the expenses of the traffic would be thereby decreased to any considerable extent. The cost of the transformation and reconstruction would be heavy, and an amortization of the invested capital would be impossible.

The five principal Swiss railway lines demand about 30,000 horse-power a day. To guarantee this, 60,000 horse-power of high-tension alternating electric current would be required, to which the necessary reserve would have to be added. The question whether the available water power of the country would be capable of supplying this power is answered in the affirmative. Thormann, without taking into consideration the powerful waterfalls, names the following works, which are either in course of construction or designed.

Name of Works:	*Horse-power.*
Sihlwerk, near Einsiedeln	20,000
Laufenburg on the Rhine	10,000
St. Maurice	5,000
Wangen on the Aare	5,000
Beznau on the Aare	5,000
Wäggithal (Schwyz)	5,000
Fribourg-Hauterive	4,000
Rheinau	3,000
Hagneck, near Biel	2,000
Doubs, near Puntrut	2,000
Vallorbe (Jura)	2,000
Lungernsee (Unterwalden)	2,000
Montbovon (Vaud)	1,500
Kander (Bernese Alps)	1,500
Sense (Fribourg)	1,000
Gurtnellen	1,500
Göschenen	1,500
Ritomsee	8,000
Giornico	4,000
Marobbia	1,000
Verzasca	1,000
Total	86,000

As this would be more than sufficient, the surplus could be used for industrial purposes.

The cost of the establishment would be very great. The writer calculates it at 161,000,000 francs ($31,073,000), viz.: Rolling-stock, 40,000,000 francs ($7,720,000); conducting cables and miscellaneous, 70,000,000 francs ($13,510,000); and generating stations, 51,000,000 francs ($9,843,000). He shows, however, that although the direct saving would not be important, the country would profit enormously, as the commercial balance of Switzerland would become more favorable and the vast amount expended for coal would remain in the country. The general utilization of water power throughout the country would also mean a valuable encouragement for other industries.

The study of Mr. Thormann has attracted much attention. That the project is no longer regarded as Utopian is proved by the meeting of electrical engineers referred to in one of my previous reports—

January 23, 1902—and more recently by the fact that the "Maschinenfabrik Oerlikon" has made an application to the Federal Government for a concession to establish a line of 20 kilometers (12.4 miles) of electric standard-gauge railway for experimental purposes. There is no doubt that this concession will be granted.

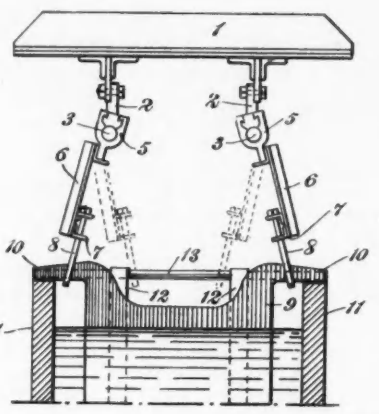
Metallurgical Crane.

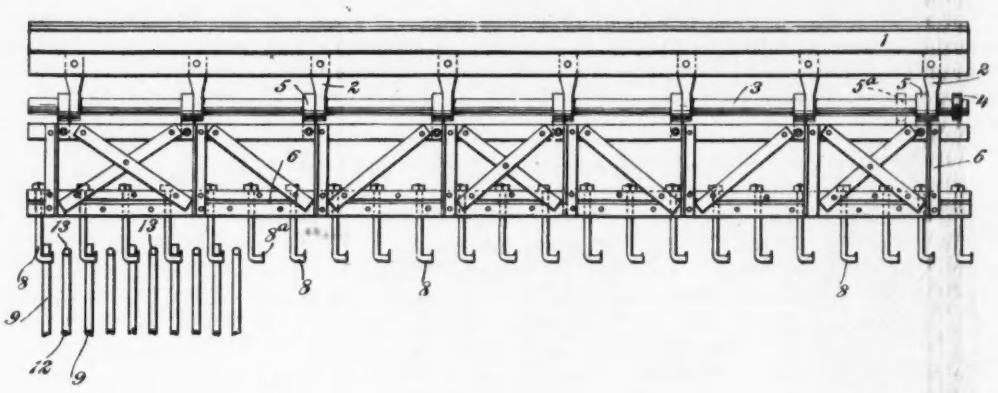
A patent, issued April 15th, figures and describes the form of a metallurgical crane which is used for handling the anode and cathode in the refining tanks of the Raritan Copper Works, near Perth Amboy, the device being the invention of Mr. David Wesley Blair.

The accompanying cuts, reproduced from the patent drawings, show the new construction in side and end elevation respectively. It comprises a supporting frame *1* for the parallel horizontal shafts *3*, which extend, as shown, above the vats and are mounted in bearings in hangers *2*. Other bearings *5* upon the shafts support two skeleton frames *6*, and these in turn carry upon brackets *7* the hooks *8*, *8a*, for engaging the electrodes. The shafts *3* are free to rock in their bearings to the position illustrated in dotted lines, and also to move longitudinally therein to an extent represented by the two positions *5*, *5a* of the bearings, and coinciding with the spacing of the electrodes in the vat.

This double movement permits the crane to perform a double function; the hooks may be swung outwardly to engage all of the anodes *9*, as shown in full lines in Fig. 2, and after the removal of these may be swung inwardly to their dotted position under the supporting bars *13* of the cathodes *12*, the longitudinal movement of the shaft bringing them into engagement therewith.

The net result is a decided simplification of the structure, a reduction of the number of parts, and the provision of means for bringing the hooks into engagement with all of the anodes or cathodes of a vat by a single movement of the support.



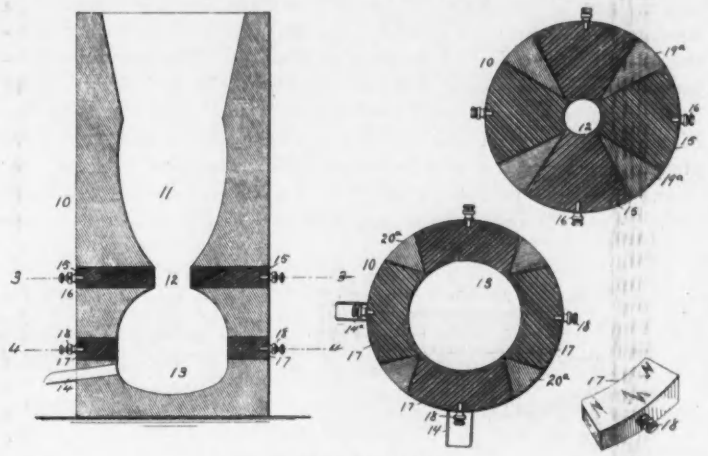


FIGS. 1 AND 2.—END AND SIDE ELEVATIONS OF METALLURGICAL CRANE.

Electric Furnace.

The electric furnace shown in the accompanying figures in vertical section and in cross-section upon the lines *3*, *3* and *4*, *4*, respectively, is the invention of Michael R. Conley, of New York, and the property by assignment of the Conley Electric Furnace Company, of the same place. The novelty of the construction lies in the use of a plurality of horizontal zones wherein heat is developed by the incandescing action of the current upon a belt of carbon and upon the charge itself.

The furnace is a fire-brick structure, provided with a contracted portion *12*, below which is a hearth *13* for the reception of the reduced metal and slag, which in operation are tapped respectively from the runners *14* and *14a*. At the contracted portion of the shaft the first heating belt is placed, formed of a number of segments *15*, of the usual graphite-clay mixture, mounted loosely between pillars *19a* of the fire-brick structure, preferably forming a continuous band around the inner wall of the furnace chamber, and capable to a considerable extent of adjustment to compensate for wear. Electrical connections from both terminals of the dynamo are made through binding posts *16*. Around the walls of the hearth, and at a considerable distance below the belt referred to, a substantially similar structure *17*, *18*, *20a*, is placed. The effect of the arrangement is to produce a furnace, certain zones of the walls of which may be rendered incandescent at will and to the degree desired, by the passage of the current. In such a construction a variety of operations are of course possible, but the inventor contemplates mainly the reduction of iron ores or the production of ingot steel.



ELECTRIC FURNACE.

International Association of Municipal Electricians.

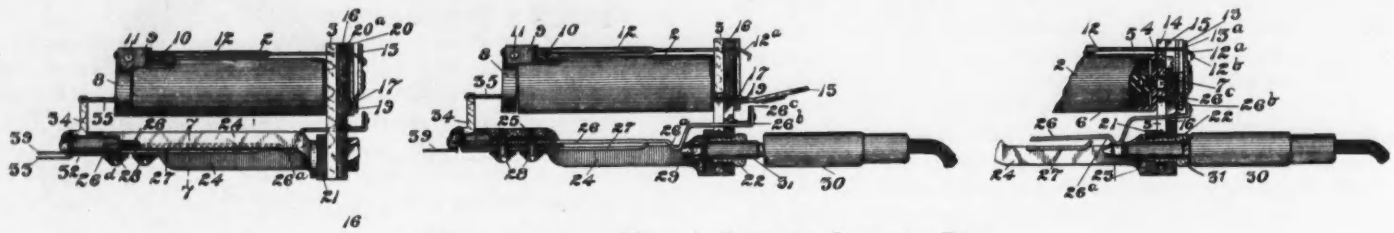
The seventh annual convention of this association will be held at Richmond, Va., Tuesday, Wednesday and Thursday, October 7, 8 and 9, 1902. The following papers will be prepared and presented at that meeting: "Municipal Inspection and Control," Walter M. Petty, Rutherford, N. J.; "Relation of Electrical Interests to Other Branches of the Municipality," Capt. Wm. Brophy, Boston, Mass.; "Classifying of Records of Electrical Departments, and Standard Specifications, for Supplies and Contracts," Edw. F. Schurig, Omaha, Neb.; "Report of Committee on Rules for Electrical Inspection and Control," especially with reference to the occupancy of streets, Morris W. Mead, Pittsburg, Pa.; "Joint Use of Conduits," Chas. F. Hopewell, Cambridge, Mass.; "The Telephone Service in Connection with Fire and Police Signal Systems," Jerry Murphy, Cleveland, O.; "Electrical Government in Small Cities," A. S. Hatch, Detroit, Mich. In addition to the papers, Mr. Hopewell, of Cambridge, Mass., will give an "Illustrated Lecture" on Fire and Police Telegraphs.

Trolley Car Propagandism.

It is noted that during the recent disturbances in St. Petersburg, the students availed themselves of the street cars, from the tops of which they managed to distribute a mass of incendiary literature among the struggling crowds and police below.

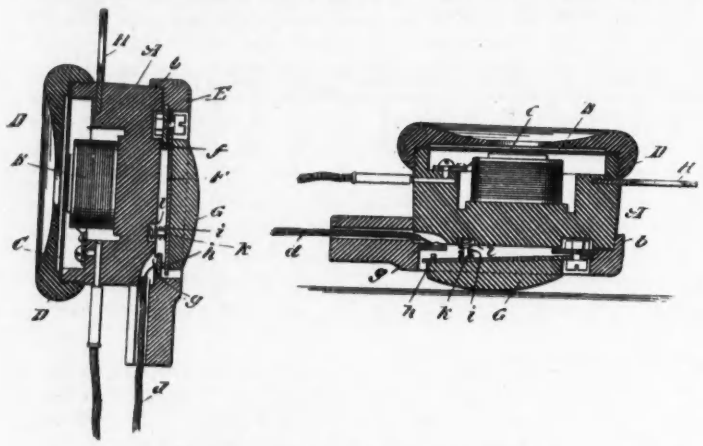
New Telephone Patents.

The issue of the Patent Office for April 15 contains two telephone patents, one relating to a switchboard detail, the other to the irrepressible receiver. Mr. Kempster B. Miller, of Chicago, patents and assigns to the Kellogg Switchboard and Supply Company, a combined jack and drop in which the line signal is mechanically restored by the insertion of the plug in the jack. The drawings illustrate the device so clearly that little description is needed. Referring to the diagrams, Fig. 1 shows the drop and jack in normal position, Fig. 2 the drop fallen and the plug partly inserted, and Fig. 3 the plug inserted and the drop restored. It will be seen that the line-spring *26* of the jack is extended through a slot in the frame and its end bent upward so as to impinge immediately below the drop-shutter. The bent end *26b* of the jack-spring may be lined with insulating material *26c*. When the plug is inserted the tip *29* forces the depression *26a* in *27* upward and so raises *26b* and effects the replacement of the drop-shutter, which is held by the hook *12a* on the end of the armature lever *12*. The raising of spring *26* breaks contact with spring *27*, and so cuts the drop-coil out of circuit.



FIGS. 1, 2 AND 3.—MILLER'S COMBINED JACK AND DROP.

Mr. Aristide Neri, of Hoboken, patents a watch-case receiver, particularly designed for interior service, with a spring circuit closer, the object of which is to prevent the exhaustion of the batteries when the receiver is left off the hook. Figs. 4 and 5 show the details of this device. At the back of the case is bolted a metal plate *F* covered by a cap or button *G* of insulating material. The plate *F* by a contact point *h* makes contact with a plate *g* when pressure is applied to *G* the contact being held normally open by the spring *i*.



FIGS. 4 AND 5.—NERI'S WATCH CASE RECEIVER.

When the receiver is in use the circuit is closed by pressing on *G*, and when it is not in use the spring *i* holds the circuit open, and there you are.

Clarkson School of Technology.

Following are some of the subjects of graduating theses, in June, of the graduating class of the Clarkson School of Technology, Potsdam, N. Y., of which Prof. W. S. Aldrich is director: "Development o fthe Water Power of High Falls on Deer River," "A Study of the Possibilities of the Development of Water Power on the Indian River," "A Design for a Power Plant on the Indian River," "Investigation of the Properties of Liquid Condensers," "In fluence of Chemical Composition on the Electric Conductivity of Wrought Iron and Soft Steels," "Performance of a Motor Generator Set *vs.* a Rotary Converter of the Same Capacity," "The Design, Construction and Performance of an Eexperimental Polyphase Transmission Line," "An Experimental Study of a Single-Phase Induction Motor," "In stallation of, and Experiments on, a 15 hp Otto Gas Engine," "Experiments on the Flow of Steam through Rectangular Orifices," "Design of Compound Marine Engine," "Development of the Water Power of High Falls on Deer River."

Proposed Independent Telephone Manufacturers' Association.

An organization of independent telephone manufacturers at Chicago has been talked of for some time, and on April 16 about a dozen manufacturers and representatives met at the Oxford Hotel, Canal and Adams streets, at the call of Mr. J. E. Keelyn. The meeting was presided over by Mr. Keelyn, who outlined his ideas of what the association might be, after which came a general informal discussion of what the objects of such an association should be, whether entirely for the purposes of good fellowship or whether it should go further and attempt to regulate business matters.

As there was considerable difference of opinion on the points, and as there was a general disinclination to pledge membership to such a manufacturers' organization until the objects and requirements were definitely settled, a committee of five was appointed to draw up rules, and report at a meeting at the same place, Tuesday noon, May 6, 1902. The committee for framing these rules consists of F. G. Jones, Geo. A. Briggs, L. G. Bowman, J. E. Keelyn and H. E. Procunier.

CURRENT NEWS AND NOTES.

ENGINE BUILDERS' ASSOCIATION.—The spring meeting of the Engine Builders' Association of the United States will be held at Hotel Schenley, Pittsburg, Pa., on May 22 and 23. Specially prepared papers will be read on the first day, and on the afternoon of the second day a visit will be made to the plant of the Westinghouse Machine Company. A banquet will be held the same evening.

GUTTA-PERCHA AND RUBBER IN GERMAN NEW GUINEA.—Consul-General R. Guenther writes from Frankfort, as follows: Two years ago, the German Colonial Society offered a prize of 3,000 marks ($714) for the finding of a plant in the German colonies furnishing gutta-percha suitable for cable purposes. A telegram from German New Guinea says that gutta-percha, as well as rubber, has been found in large quantities.

ELECTRICITY AND WESTERN ROADS.—The *Wall Street Journal* has the following: Perhaps the most elaborate undertaking now occupying the attention of electrical engineers, is the project of President J. J. Hill, for utilizing the forces of the mountain torrents now going to waste in the Cascade range to haul loaded trains over the mountain passes from Eastern Washington to the Pacific slope, and back again. With this purpose in view, engineers of the Westinghouse Company are now considering the resources at their command, preparatory to making plans for the practical realization of what is in Mr. Hill's mind. Explorations have been made in the Cascades and numerous water courses discovered which may be utilized for the creation of energy. The project of harnessing the Spokane Falls and the transmission of the power thus generated across the plains of Eastern Washington to the mountains is even considered a feasible and practicable plan. Not only is the waste power of the waters to be utilized, but steam generated at coal mines in the Cascade range is to be used to create electrical energy for the same purpose.

CHICAGO ELECTRICAL ASSOCIATION.—The May meeting of the Chicago Electrical Association to be held May 7, at 1739 Monadnock Block, is to consist of a discussion of "The Central Station vs. the Isolated Plant."

STATUE OF LIBERTY'S LIGHT TO SHINE.—Secretary Root has made arrangements to maintain a light in the Statue of Liberty, on Bedlow's Island, and in New York Harbor. The electrical apparatus belonging to the lighthouse establishment and used by it in lighting the statue will be employed for that purpose. This action is the result of a personal conference with the Secretary of the Treasury, and was taken with the approval of the President.

THE ELECTRIC TOWER.—It has been recently reported that the Electric Tower of the late Pan-American Exposition had been bought by the city of Denver, and would shortly be removed to that city. This report has called forth a great amount of protest from the public-minded citizens of Buffalo, with the result that efforts are now being made and contributions offered for the purpose of retaining the structure as a permanent memorial of the late Exposition, in the city of Buffalo.

ASSASSINATION AND TROLLEYS.—The Russian Minister of the Interior, M. Sipiaguine, has been assassinated by a Socialistic student. A cable dispatch from St. Petersburg, of April 15, says: The death of Sipiaguine may materially affect the chances of Murray A. Verner, the Pittsburgh contractor, of securing the St. Petersburg tramway franchise, as the dead man was a notable supporter of Mr. Verner's proposition, and overruled the committee which had recommended the Westinghouse offer. The matter, possibly, is now indefinitely postponed.

RAILROAD TELEGRAPHY.—The Delany rapid telegraph system, which has been in regular operation by the Pennsylvania Railroad between Philadelphia and Altoona for the past six months, is to be immediately extended to Harrisburg and Pittsburg. The new apparatus was ordered some time ago, and is ready to be installed as soon as the Pittsburg station is ready. About 500 messages, equivalent to 1,000 ordinary commercial messages, are sent daily by the Delany method over the Philadelphia-Altoona wire, which includes a telephone circuit in constant use without in the least interfering with conversation.

WIRELESS TELEGRAPH CONFERENCE.—A cable dispatch from Berlin, of April 16, says: Great Britain has accepted Germany's proposition for an international conference to regulate the use of wireless telegraphy. The other powers to which the proposition was made, namely, the United States, France and Russia, have not yet responded, but the officials here confidently expect favorable answers, especially from the United States, which has taken much interest in the matter. Germany's suggestion embraces merely the calling of a conference without definitely formulated propositions for discussion. However, Germany has asked the powers to set forth in their answers if they wish Germany to formulate propositions to lay before the conference, or leave the matter entirely to the conference.

CHICAGO TELEPHONY.—A telegram from Chicago says: A thirteen-year extension of the Chicago Telephone Company franchise in return for an agreement to the readjustment of rates which will give the public much cheaper service, is the proposition that the special Council Committee on Telephones has put to the telephone officials. If the company refuses to agree to the plan, the committee will recommend to the council the readjustment of telephone rates without the franchise extension, and will ask that the new and lower rate be enforced. It is considered likely that an agreement will be reached. The company's franchise expires in seven years. The telephone company officials have discussed for some months the advisability of seeking an extension before making further improvements.

ELECTRICAL STEERING APPARATUS.—Lieut. Bradley A. Fiske in a patent dated April 15 describes a method for operating steam steering engines by electrical means. Geared with the steering wheel is a small induction motor, conductors from which go to a similar motor at the steam steering engine. A pin on the shaft of the latter engages with a lever connected with the reversing valve of the steering engine, and normally held in mid-position by two opposing springs. When the steering wheel is turned, the current generated in the wheel motor produces a torque in the engine motor, which operates the valve lever and raises or lowers the valve according to the direction of motion of the steering wheel. When the steering wheel stops, current is no longer generated and the springs above referred to bring the lever and reversing valve back to mid-position, thereby cutting off steam from the steering engine.

"MODERN MACHINERY."—The crazy product of a decadent art school is thus spoken of in a New York *Tribune* dispatch from Paris, describing the present Salon: The picture likely to hypnotize the public is "La Machine," of which the artist is Jean Veber. It is a large work, superb in color and superbly drawn. A huge dynamo is in rapid motion. On a steel cylinder is perched a nude female figure whose red hair stands on end by the force of electricity, while the ponderous fly-wheel is crushing to atoms hundreds of human bodies, the victims of industrial trusts and commercial syndicates, while a river of blood flows beneath. This apocalyptic machine picture has an irresistible fascination, in spite of the repulsive subject and the artist's baneful misconception of modern civilization and progress. "Modern Machinery" is to this year's Salon what Jean Beraud's scarlet "Christ at the Pillar" was in last year's Salon. It is a socialistic atrocity, but every one gazes at it, every one talks about it. It arouses anger and indignation, but Veber's most caustic critics admit that among the younger generation of French painters there is not one that can equal him in warmth and brilliance of color. It is a pity he cannot find better employment for his skill.

ELECTRIC TRACTION IN GERMANY.—A cable-dispatch from Berlin, of April 9, says: Herr von Thielen, the Prussian Minister of Public Works, speaking in the Diet to-day on the railway budget, referred to the application of electricity to broad-gauge, long-distance railways. He reviewed the recent experiments on the Wannsee and Zossen roads, and said that traffic on the former, which is a Berlin suburban line, has been abandoned because electricity as a motive power was twice as expensive as steam and less secure from accidents. The insulation was never wholly perfect, and he was, therefore, convinced that the high-power, long-train system could not be adopted for general introduction. The Minister said, however, that the authorities were negotiating with an electrical company to introduce elęctrical traction on all trains between Grosslichterfelde (seven miles from Berlin) and the capital, with prospects of better success. Referring to the single car experiments on the military road between Berlin and Zossen, where a speed of 100 miles an hour was reached, the Minister said he hoped for increased speed through the strengthening of roadbeds, though he was still doubtful as to whether high-speed electrical traction was profitable. He said it must be confined to passenger traffic.

THE PACIFIC BRITISH CABLE.—The British Pacific cable has reached the Fiji Islands. The laying of the cable was decided upon at the Colonial Conference, held in London in 1887, but the survey was not completed until 1899. After the report was published in 1899, an agreement was entered into by the imperial government with Canada and the Australasian colonies for the construction, laying and maintenance of an all-British Pacific cable. It was arranged that the cable should be vested in a Board of Commissioners, to be appointed under the authority of the Imperial Parliament, and that the governments concerned should appoint administrators in proportion to their shares in the undertaking, the Imperial Government and Canada each taking five-eighteenths, and New South Wales, Victoria, Queensland and New Zealand one-ninth each. The board, it was arranged, should issue debentures for the payment of capital and interest, which would become a first mortgage on the cable property and its earnings. All the landing points are to be on British territory. The highest estimate of the cost is $10,000,000, and it is thought that the interest on this sum at 2½ per cent. (that is $250,000 a year), with the cost of repairs and the charge for a sinking fund for the replacement of the cable, might be easily covered by the probable earnings, even at a very low tariff as compared with the existing one.

A MOTOR LOCKING DEVICE.—A patent issued April 15 to W. B. Potter describes an arrangement whereby current cannot be turned on railway motors faster than is desired, but which has no effect on the backward movement of the handle. Two magnets control a circuit-breaker, the function of which is to lock the controller should a current pass higher in value than a predetermined amount. When the motors are in series relation, the two controlling magnets are in series; and when the motors are in parallel relation, the two magnets are in parallel—an arrangement on the controller producing these combinations. When the current passing rises above the predetermined value, the magnets open a shunt circuit, the result of which is to cause the controller cylinder to be locked until the current again falls to a safe value.

PACIFIC CABLE STATION.—The Pacific Commercial Cable Company, on the advice of Vice-President Geo. G. Ward, has selected the landing for the Pacific cable at a point about one-half mile south of the Cliff House. Seven miles of underground conduits will be required to carry the wires from the landing to the offices of the Commercial Cable Company, in San Francisco. The first section of the cable, extending to Honolulu, will be about 2,100 miles in length, and will probably be completed during November of this year. The cable is being manufactured in England at the rate of 20 miles per day, and will be laid by the cable-ship Silvertown. The ocean between San Francisco and the Hawaii is nearly three miles in depth. The Philippine section of the cable is expected to be completed early in 1904. Communication will also be opened with Japan and China. The United States steamer Nero is now engaged in surveying the route.

MAGNET RAZOR SHARPENER.—It is claimed in a patent granted April 15 to Oscar Newhouse, that a razor may be sharpened by merely placing the cutting edge in close proximity to the surface of a bar magnet. The inventor claims that the effect of the magnet is to draw into line the minute teeth or projections of the sharp edge, which normally are at different inclinations to the blade. He states that after tests lasting for months he has found that the beneficial effect is very marked, so much so that a razor can be used a great many times without stropping or honing, it being only necessary to place the razor in proper position relative to the magnet after shaving, and allow it to remain for a period of time until it is used again. He adds that the action of the magnet has practically the effect of stropping or resharpening, and that indeed a much truer and better cutting edge is thus obtained than can be secured by resharpening. As a bar magnet is used of about the length of the razor blade, it would be interesting to know what explanation the inventor might offer to account for the sharpening of the part of the blade which is over the middle of the magnet.

ELECTROLYTIC RECOVERY OF METALS.—The idea of electrolyzing an ammoniacal solution of nickel at the cathode of a divided cell, while employing as the anode a soluble metal other than nickel, preferably the crude nickel-copper matte, and as the anolyte, a solution of common salt forms the basis of a patent issued April 15th to Hans A. Frasch, of Hamilton, Canada. The apparatus used was patented about a year ago, and was illustrated and described at the time; it comprises a tank over the bottom of which the matte is distributed in comminuted form, and above it a layer of sand which serves as a diaphragm. Anode connection is made to the matte through rods of carbon projecting through the sides of the tank, while the cathode plates are suspended in the electrolyte above the sand. In the operation of the method the matte dissolves at the anode to form a mixed chloride solution which is withdrawn by a circulation system, and the disposal of which forms no part of the method as now disclosed; in practice, however, it has been subjected to a further electrolytic treatment for the separate precipitation of the contained metals. At the cathode nickel is said to separate out in reguline form, while the ammonia, simultaneously liberated, is available for the production of additional quantities of the nickel-ammonium salt, which constitutes the catholyte. There would be also, it would seem, an ever-increasing quantity of sodium-hydrate present at the cathode, but with reference to this and its disposal the patent specification is silent.

CONVERTER DAMPER.—In a patent granted April 15 to E. J. Berg, another form of damper is added to the already long list of these devices, having for one object the prevention of hunting of rotary converters. The specification states that where bridges of conducting material are used between the pole pieces of alternating current machines for the purpose of securing uniformity of rotation, a wasteful production of eddy currents results when the armature is provided with teeth, as is usually the case. These eddy currents are to be distinguished from the occasional or periodic currents which are set up in the bridges only when the machine hunts or when there is some other cause producing changes of armature reaction. Such eddy currents have no useful effect, and in some cases appreciably reduce the efficiency of the machine. To obviate this objection the bridge of conducting material between pole pieces is provided with slots parallel to the slots of the armature and of a width and pitch equal to the width and pitch of the slots in the armature. It is stated that by this construction the teeth in the armature as they pass across the face of a bridge, are so related as to produce in each of the bars of the bridge, e. m. f.'s of practically equal intensity and of the same direction. Owing, however, to the absence of conducting material between the bars, no short paths are provided for resulting currents. The slotting of the bridge, therefore, has the effect of reducing the eddy current loss, though not necessarily eliminating it wholly.

TESLA SPLIT-PHASE PATENTS.—The United States Circuit Court of Appeals of the Sixth Ohio District has rendered a decision sustaining the Tesla split-phase patents of Dec. 26, 1893. The decision was on an appeal from the lower circuit court in a suit for the infringement of the above patents as applied to a fan motor. The defence in both cases was that the invention of the above-mentioned patents had been the subject of an earlier patent issued to the same inventor Dec. 3, 1889, on an application filed May 20, 1889. The applications for the first mentioned patents were filed Dec. 8, 1888. The court held that the earlier patent relates to the construction of motors and circuits capable of utilizing the properties of self-induction and the resistance in the circuit, to effect the delivery of alternating currents such as to induce a sustained rotation of the motor. The claims are for special means or apparatus designed to be employed in carrying out the inventor's method of operating his motor as described in the later patents. Since the invention of the specific means covered by these claims, and the generic invention of the later patents were for independent inventions, and neither had been given to the public, the court held that it was competent for the inventor to take out a patent for each; and that in such case it is not material that the taking out of one patent was prior to that of the other. The subject matter of the later patents—that is, the invention covered by them—was not a component part of the former invention, but was an independent invention not necessary to the composition of the first, or included in it.

MULTIPLE CONDUCTOR SYSTEM.—A patent granted April 15 to A. D. Lunt describes a multiple conductor system in which, by the employment of two rotary converters, a large number of combinations of different e. m. f.'s may be obtained in connection with a two-wire direct-current supply circuit. The direct-current side of a converter is connected with the supply mains, and the alternating current leads are connected to two compensators or inductance coils, the middle point of these coils being connected by a common conductor, which is thereby maintained at a neutral potential with respect to the armature winding. The inductance coils are tapped at a number of points, which connect with the points of a switching device, so arranged as to co-operate with these taps to connect predetermined portions of the length of each inductance coil to a set of alternating current leads extending to corresponding collector rings on a second rotary converter. To the brushes on the direct-current side of the second converter are connected two working conductors. In the system as described, there are, therefore, five conductors, namely, the neutral above referred to; the two conductors from the second converter and two conductors connected with the direct current source of supply. By manipulating the switch above referred to, the two conductors connected with the brushes of the second converter may have impressed upon them different e. m. f.'s; in this manner the e. m. f. of these conductors may be varied so as to approach that of the neutral conductor, or to approach or even exceed the e. m. f. of the two conductors connected with the source of direct current supply. By this method and using two converters and two compensators or inductance coils, a large number of combinationsof different e. m. f.'s may be obtained between the five conductors constituting the multiple conductor system.

PUPIN COILS.—In a patent granted April 15 to Prof. Pupin and S. W. Balch, an ingenious mechanism is described for winding the type of annular induction coils used in connection with the Pupin system for reducing the attenuation and distortion of telephone currents. The coils—designated as "ballast" coils—have an annular core, usually of an interior diameter of about one-half the exterior diameter, and having a cross section either approximately circular or square with the corners rounded. On this core there are two windings, each extending nearly half way around the core, and the machine provides that each winding shall contain only the exact number of turns necessary.

MOTOR GENERATOR REGULATION.—A patent issued April 8 to T. W. Williams describes a means for regulating the direct-current circuit of a motor generator driven by a synchronous motor. In series with the field of the direct-current generator is a small direct-current dynamo direct-connected to a small induction motor. Across one of the two angularly displaced windings of the induction motor is shunted a circuit having in series an inductance and capacity, the values of which are such as to exactly neutralize each other when normal transmission exists upon the alternating-current line. Under these conditions the currents in the two windings are in phase and there is no rotation of the motor. Should the frequency of the alternating-current circuit be increased, the current in one of the induction motor coils will be displaced in phase from that of the other coil, and the motor will operate; an e. m. f. will then be generated in the small direct-current generator, which e. m. f will act in opposition to that of the field, thereby lowering the voltage. When the frequency falls below normal, the e. m. f. will act in conjunction with that in the field, thereby increasing the e. m. f. of the field. The patent also describes another method for accomplishing the same purpose, consisting of an arrangement like that of Baxter for cutting in and out field resistance by means of a centrifugal governor attached to the motor-generator shaft.

LETTERS TO THE EDITORS.

Genesis of Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

Sirs.—I note in your issue of April 19 an article on the genesis of Hertzian telegraphy. I have been very much interested in reading carefully this summary of what has been actually achieved in the art, and welcome it as a well-judged effort to enlighten your readers on the status of a matter which has been greatly beclouded by conflicting claims. As I read your article, it is an effort to point out and summarize what has actually been done in perfecting an art available to the public as distinguished from a mass of experiments which have not led anywhere. If it were not for this belief in your purpose, which is obviously sincere and disinterested, I should be very much inclined to object to the omission of the names of such men as Dolbear and Tesla, both of whom, it seems to me, have presented claims in regard to this work, entitling them to a consideration. I think some of your readers beside myself, interested in this great new field of work, would welcome a little further elucidation of the distinction which you make in your article between performance and achievement.

BOSTON, MASS. C. L. RAINFORD.

[With regard to the objection and comment on our editorial of last week, we can only say that it was dictated in response to numerous inquiries which have reached us with regard to the validity of many of the statements made recently touching wireless telegraph work. The assertions in the daily newspapers, many of them attributed to well-known men, have been so extraordinary as to well deserve notice of some kind, and we felt that we could hardly let them pass without endeavoring to clear up the situation so far as it presents itself to our view. It was distinctly our aim, as the editorial shows for itself, to emphasize progress in the "creation of an art" as distinguished from a mass of speculation and experiment, in regard to which only failure has been noted, or with respect to which only the future can determine its worth. Our readers perhaps do not realize the amount of work that has been done in this new field, but we may note that the admirable work of Dr. Turpain on telegraphy with electric waves enumerates the names of no fewer than 135 separate inventors and experimenters, and we could ourselves supplement his list with at least a score more. In our necessarily brief review of the "art" we mentioned—with the single exception of Crookes—only those who had distinctly contributed to it, and whose principles and apparatus are actually embodied in the systems which one can use and pay for. Prof. Dolbear's interesting work has virtually been disposed of in the courts as to its value. We have great hopes as to the success that Mr. Tesla will attain in his efforts. But although his published speculations in this field go back to 1893-4, and although several patents have been issued to him, and although sundry newspapers have had a good deal to say on the subject of what he proposes to do, we do not know of any authentic wireless telegraphic work of Mr. Tesla, nor can we point to any article in our own or any other electrical journal showing that he has ever sent ten words ten yards through the air or earth. It is quite possible that such authentic records exist, but failing their publicity, it is obviously impossible to include them in the review of a commercial art such as was made in our editorial.—EDITORS OF ELECTRICAL WORLD AND ENGINEER.]

Production of Gutta Percha.

To the Editors of Electrical World and Engineer:

Sirs.—My attention has been called to what seems erroneous in Major J. Orton Kerbey's article in your paper of Feb. 3d. The article is very interesting and seems encouraging in some ways, but if you have correctly printed his figures, his estimate of the value of gutta, and of rubber trees seems calculated to boom a planting syndicate. The estimate of total exportation is nearly 50 per cent. higher than any statistics I have before seen, and the estimate that it has cost the life of 150,000,000 trees, which were cut and all of the gum taken from them to produce 300,000,000 pounds of gutta-percha, an average of two pounds per tree is probably proportionally correct. The Chinese, who have charge of this, know enough to take the tree at its prime, and if so how could it produce 10 times as much in each year for 20 years? I think that 2 pounds per year would be nearer the mark, and I doubt the possibility of getting anything like $10 worth per year from the best trees.

NEW YORK CITY. HY. A. REED.

Burning from Arc Rays.

To the Editors of the Electrical World and Engineer:

Sirs.—The many readers of your valuable paper may be interested in an account of a severe case of burning of the tissues of the skin from prolonged exposure to a powerful electric arc.

I have been experimenting with a process for burning out chilled iron at our blast furnaces here by means of the electric arc, using

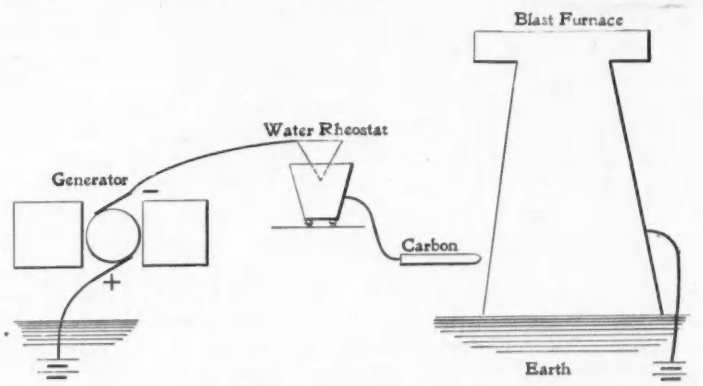


DIAGRAM OF CONNECTIONS.

the current from a Siemens-Halske 300-kw, machine-wound for 250 volts, connecting it up in the manner illustrated by the accompanying diagram. Using a carbon 2½ inches in diameter and 72 inches long, the current varied from 1,200 to 1,400 amperes. The voltage was kept from 180 to 200 volts, and the current penetrated

rough iron mixed with dirt and slag, making a 6-in. hole at the rate of about 30 inches per hour.

I protected my eyes by using triple glasses of the deepest orange tinge, but had several men laid up from trying to look at the arc with the naked eye. After the first trial, in which I personally manipulated the carbon and was exposed probably for an hour and a half, I found on rising the next day that the entire skin of my face, arms and neck—in fact all parts exposed to the light of the arc—were read and inflamed like a severe sunburn. The effect continued to grow worse, acting in a similar manner to a Roentgen-ray burn, and only yielded to treatment after a long time, when the flesh peeled off, leaving the face very tender and sore.

I think that a mask of material impervious to Roentgen rays would prove a protection, and I am having one made for future experiments. Very probably this account may prove of benefit to others who are experimenting along the same line, or in any manner in which they are exposed to a powerful arc light.

LORAIN, O. C. H. HINES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Self-Exciting Compound Alternator.—LATOUR.—An illustrated article, which is a continuation of his articles on self-exciting series and shunt alternators recently abstracted in the Digest. In a direct-current shunt-wound dynamo the brushes are at no load placed in a direction perpendicular to the direction of the poles. When the dynamo is loaded, the brushes must be moved in the direction of the movement. and there is a drop of voltage due to certain magnetic effects of the current in the armature. Fischer-Hinnen and Ryan have long since found a method for counteracting these effects by placing in notches on the pole-pieces of the machine, conductors through which the total armature current flows in such a sense that it counteracts the magnetic effects of the armature. This method will exactly fiulfill the desired purpose, if the field of a shunt dyanmo has the annular form of a stator of a rotary field motor. The field would be provided with a winding indentical with that of the armature. He calls this method, known under the name of Ryan winding, the "rational" compounding of the shunt dynamo, in distinction from the ordinary method of compounding by placing thick wire coils on the field coils or on projecting poles. The rational compounding annihilates the flux due to the armature not only in magnitude but also in direction; a shunt dynamo with an annular field has an invariable position of the brushes and constant e. m. f. for varying load. This rational method of compounding is essentially applicable to the self-exciting shunt alternator (Digest, April 5). As shown

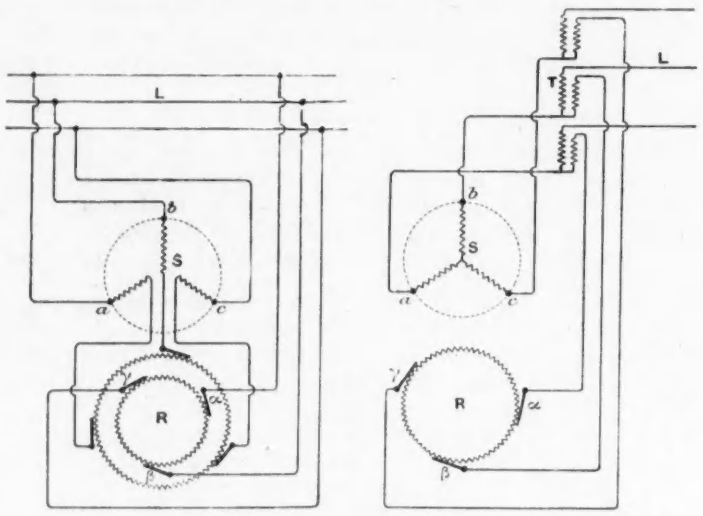


FIG. 1 AND 2—SELF-EXCITING COMPOUND ALTERNATOR.

in Fig. 1, it is sufficient to add on the primary rotor of the alternator, a series winding with special collector to the shunt winding of excitation. The star connected windings of the stator are closed in delta fashion in this auxiliary rotor winding by means of three brushes properly placed. By means of this composite excitation the brushes can be fixed, the frequency remains constant and so does the e. m. f. induced in each phase. The alternator could even be loaded in two phases only and become a single-phase alternator; it would remain compound. This is, therefore, a general and safe method of compounding; but the two windings and the two collectors on the primary rotor, would complicate the alternator and increase the copper weight of the primary. Fortunately the superposition of the series excitation and the shunt excitation can be obtained in a very simple way in the same winding, by means of a compound transformer *T*, as shown in Fig. 2. He does not give the mathematical theory of this arrangement, but states that it enables the brushes to be fixed.—*L. Ind. Elec.*, March 25.

Direct-Current Motors with Variable Speed.—HUNDT.—An illustrated article. The regulation of the speed of a shunt motor by means of inserting resistance into the armature circuit, is not economical on account of the large energy losses; and the speed also depends much on the load with this kind of regulation. A better method—especially with reference to the efficiency—is the method of shunt regulation by which the current in the field magnet windings is changed with a resulting change of the field flux; but this method of regulation is limited by the consideration of sparkless running of the brushes. A much better method of regulation is claimed to consist in the change of the air gap between armature and poles; and it has the advantage that when the air gap is increased, and, therefore, the speed is increased, then the number of ampere turns required for the induction in the air gap is increased, which is of advantage for sparkless running. Besides this it then becomes possible to use this method together with shunt regulation. He gives diagrams of a two-pole, 6-hp, 500-volt motor, the speed of which can be varied between the limits of 350 and 1,500 revolutions with a nearly constant efficiency of 83 per cent. With a constant exciting current of 0.4 amp., the speed is varied between 350 and 1,000 revolutions by varying the air gap; the speed is further increased up to 1,500 revolutions by reducing the exciting current to 0.28 amp. The variation of the air gap is produced by means of a cam encircling the motor, a revolution of the handle by 70 degrees, corresponding to a displacement of each pole by 16 mm.—*Elek. Zeit*, March 20.

Armature Interference and Brush Position.—HOBART.—The conclusion of his article. He made some tests on a 10-pole, 90-revolution, 550-volt, 550-kw generator. Tests of the excitation regulation were made with the brushes set successively in the neutral position, and with 4, 8 an 12 segments forward lead. The increase in excitation from no load up to one-half full load, required to maintain 550 volts, was 16.5, 21.0, 25.0, 33.0 per cent. for 0, 4, 8, 12 segments lead of brushes, respectively. The machine was one constructed on the ordinary lines, and not for operation with backward lead. For that purpose lower reactance voltage and higher armature strength would be required. A number of excitation regulations curves are given in diagrams.—Lond. *Elec. Rev.*, March 21.

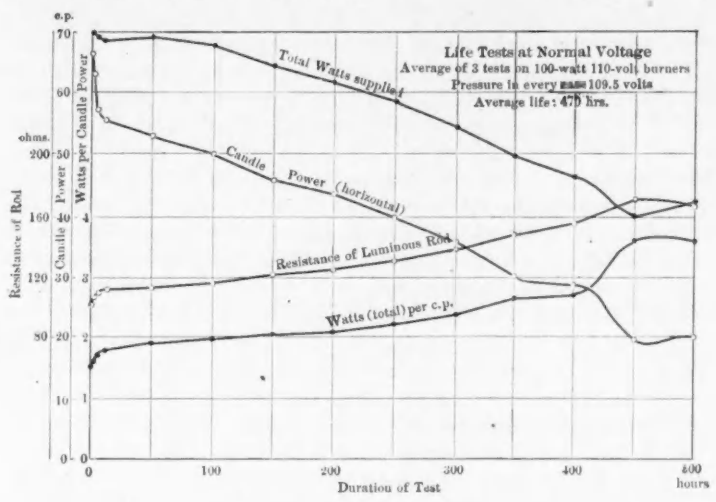
REFERENCE.

Direct-Current Armatures.—ARNOLD.—A long and profusely illustrated mathematical paper on the theory of equipotential connections in the armatures of direct-current machines. The article cannot well be abstracted, as it is very theoretical. He recommends the equipotential connections, especially for multipolar dynamos. They are used to a great extent by Lahmeyer & Co.—*Elek. Zeit.*, March 13, 20.

LIGHTS AND LIGHTING.

Nernst Lamp.—HULSE.—An illustrated abstract of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng., giving an account of tests of the "1902 model" of the Nernst lamp, fitted with 100-watt, 110-volt burners (evidently made by the Gen. Elec. Co. of Berlin). They were tested with continuous current only,

from a storage battery, the pressure being steady within half a volt. The behavior of the Nernst lamp is given in the adjoining diagram, the curves representing the average of three lamps. They broke down after 509, 490 and 425 hours. The end comes in all cases by the breakage of the platinum contact at the positive end of the rod. It is evident from the diagram that the lamps are done within about 40 hours, but that a very fair economy is retained almost up to that point. The natural life is very close to the "economic life"; therein it differs greatly from the ordinary incandescent lamp, which, if not removed, goes on running long after its efficiency has departed. As regards the Nernst lamp, the conclusion is that it will pay to get a new "burner" after 350 hours. Nernst lamps cannot be overrun, as the iron resistance protects the burner from excessive pressure; and there is no use to attempt it, as the watts per candle are very little less, while the life comes down to 200 hours, when the pressure is 116.5 volts for a 110-volt lamp. If underrun, the life is enormously prolonged. A lamp on 105.8 volts may last 1,200 hours, but it is then giving 9 candles instead of 50, and taking



CURVES OF NERNST LAMP.

6 watts per candle. At 600 hours it takes 3.48 watts per candle, or is hardly better than an ordinary incandescent lamp. He believes that under-running might pay where current is cheap; a peculiarity is that the current, and with it the candle-power, are liable to fluctuate. The financial side of the matter is summed up as follows: "The Nernst lamp will give on the average throughout a life of 400 hours at least .48 cp per watt expended, as against not more than .28 cp per watt in the case of good glow lamps. The cost of renewals would appear to be not more than three times as much for the Nernst as for the glow lamp, allowing for the shorter life of the former. In a 100-watt Nernst lamp the total energy used is over 35 units during economical life, and at 8 cents a unit this costs $2.80 or, say, not more than $3.75, when all expenditure due to renewal of the burner is taken into account. Thus the Nernst lamp will furnish 1,000-cp hours at a cost of 22 cents; while 30 cents is the approximate cost of the same amount of illumination from good glow lamps. In this comparative estimate the cost of renewals in each case has been included, the price per unit assumed to be 8 cents, while the glow lamp has been taken at an average of 3.6 watts per candle-power throughout a life of 700 hours." He anticipates a wide field of use for the lamp where fairly large candle-powers are required and power is not cheap.—Lond. *Elec. Times,* April 3; an illustrated reprint in full of the paper is begun in Lond. *Elec.,* April 4.

Mechanical Equivalent of Light.—ANGSTROEM.—A short article describing some recent researches which he made. After referring briefly to the work of Thomson and of Tumlirz (see *Electrical World,* April 20, 1901), he describes his own experiments which were made with a Hefner amylacetate lamp. He gives the figure of Tumlirz for the total radiation in a meter candle as 0.0000148 gram calories per second, and the light effect of the radiation 2.4 per cent. of this; he claims, however, that the method of measuring the light effect, by absorption in water, is fundamentally wrong and must give values that are too high; an early determination by the author showed agreement with this figure for the total radiation. In his present method he determined the total radiation and then the ratio of the light radiation to the total. The former he determined by a compensation "spyrheliometer," which he constructed; he measured it at 500 and at 100 cm, and obtained concordant results; the mean value obtained for a distance of one meter was 0.00129 gram calories per minute, with a possible error of 3 per cent. (he does not state what solid angle this comprised). The light effect of the radiation was measured as follows: The beam was passed through a spectroscope, and by means of a screen the non-luminous rays were cut off while the luminous rays were passed through a cylindrical lens which united them, forming a white light again, and this was thrown on a photometer screen. A second and identical lamp was placed at the other end of the photometer bar and adjustment made for balancing the two. There were thus two radiations which were physiologically of equal strength and composition, one containing only the light rays, while the second contained the total rays. The photometer screen was then replaced by a bolometer or thermocouple, with which the energy of the two radiations and their ratio could be determined. A water screen between the cylindrical lens and the photometer screen cut off the heat rays coming from the screen. As a means of several determinations of the light effect he found the ratio of these to the total radiation to be .90 per cent (that is slightly less than 1 per cent.) with a possible error of .04 per cent. From these determinations he calculated the energy of this unit of light, namely the energy of the light rays on 1 sq. cm at a distance of 1 cm, and the unit of illumination, that is, the energy of the light rays on 1 sq. cm at a distance of 1 m; for the former he found 81,000 ergs per second, while for the illumination equal to one meter candle he obtained 8.1 ergs; the mechanical equivalent of the unit of illumination is, therefore, in round numbers, 8 ergs per second. For the acetylene flame he obtained as the ratio of the light to the total radiation, 5.5 per cent, which is only about one-half of that obtained by Stewart and Hoxie, whose measurements he considers faultly.—*Phys. Zeit.,* March 15.

POWER.

REFERENCES.

Angular Speed of Prime Movers.—CORNU AND BLONDIN.—A paper by Cornu describing an investigation of the variations of the angular speed of the fly-wheel of an Otto gas engine by the stroboscopic method. Another paper by Blondin, on the methods of measuring the angular deviation of a machine, and especially on the stroboscopic method of Sartori.—*Bull de la Soc. Int. des Elec.,* Jan.

Starting Gas Motors.—SCHINDLER.—An article illustrated by numerous diagrams. When an electric generating station contains gas motors, a means must be provided for starting them. This is often done by running the dynamo as motor from another source of current, for instance a storage battery; he gives several diagrams of connections suitable for this purpose.—*Elek. Anz.,* March 30.

TRACTION.

Three-Phase High- Tension Railway.—GOLWIG.—A long, illustrated description of the first Austrian three-phase high tension railway, in regular satisfactory operation near Vienna. It is only a short line, which connects a government ordnance factory with a railway station. In that factory a 3,000-volt, 42 periods, three-phase current system has been in use; for that reason it was decided to operate the railway, which was formerly operated by steam, by three-phase current, and at a voltage of 3,000, in order to use this road at the same time as an experiment. The locomotive is provided with one 50-hp, 3,000-volt three-phase current induction motor. The currents of two phases are supplied to the locomotive through two trolley poles which take off the currents from two copper trolley wires; the rails are used for the third-phase. There are two sets, each of two trolley poles, on the top of the locomotive; each set corresponds to a certain direction in which the train runs; hence one set is always lowered. The 3,000-volt currents are supplied to the stator. The motor has a speed of 600 revolutions, and is geared to the axle, the ratio of the gearing being 1 to 6. The secondary or induced currents in the rotor have a maximum e. m. f. of 300 volts when the secondary circuit is open. The secondary currents are taken off from the motor by means of slip-rings and are led to a water rheostat, consisting of brass plates of different length suspended in an alkaline solution. When one wants to cut out resistance, the solution is pressed upwards by air pressure, in such a way that the inserted resistance is a minimum when the level of the solution has reached the highest position. At this moment when the motor reaches full speed, a floater which floats on the rheostat

liquid, closes the valve of the air pressure, with the result that a metallic short circuiting arrangement is set into operation which short-circuits the three poles of the rotor entirely. The air pressure is regulated by an air compressor driven by a 100-volt, 2-hp, three-phase motor. The current for this motor and for the lighting of the locomotives is obtained from a small transformer, the primary terminals of which are connected to the 3,000-volt supply circuit. Special safety devices are in use. The system, which has been installed by Ganz & Co., has been in regular service for a month, and works to entire satisfaction. A remarkable feature is the very smooth starting of the locomotive, due to the gradual adjustment of the water rheostat.—*Zeit f. Elek.*, March 16, 23.

Trolley Wire Hangers Used in Minneapolis.—An illustrated description of a type of trolley wire hanger for a bracket pole, designed to avoid the possibility of breakage of the insulator on the ordinary hanger, due to its rigid adjustment to the bracket. The hanger has two clips mounted on the end of a wooden stick about 1⅜ inches square. The stick is suspended from the bracket or span wire by a square link, which fits loosely over the stick, so that the latter can move back and forth through the link. This movement, however, is limited to 3 inches by spilt pins. This hanger is said to have given such satisfactory results on bracket center-pole construction that it is now used on both bracket and span-wire construction.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

REFERENCES.

Electrolytic Destruction of Pipes by Return Currents of Tramways.—Ulbricht.—An illustrated mathematical discussion of this problem. He finds that it would be hazardous to try to avoid the electrolytic destruction of the pipes by connecting them with the return feeders. He seems to favor the insertion of insulating sections into the pipes.—*Elek. Zeit.*, March 13.

Tests on Power Consumption in Liverpool.—A table giving the power consumption in running two trains, one slowly and the other faster. The watt hours per ton mile were 110, in the first case, and 137 in the second case.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

Multiple Unit Systems.—The first part of a well illustrated article. After some general remarks the Sprague system is described.—*L. Ind. Elec.*, March 10.

Statistics of Tramways in Great Britain and Ireland.—Tables are given showing the capitalization, length of track, cars, passengers carried, gross receipts and operating figures of the different tramways in the United Kingdom.—*St. R'y Jour.*, April 5, and *Int. Ed.*, April.

Installations. Systems and Appliances.

Central Station Statistics.—Ross.—An abstract of a paper read before the Electrical Society of Vienna. He first gave some statistical results of the development of the gas industry in 25 large cities in Germany and Austria, from 1890 to 1900. During this time the population increased by 24 per cent.; the production of gas by 49 per cent.; the percentage of gas consumed for lighting purposes was 93 in 1890, and 70 in 1900; the percentage of gas consumed for power purposes and heating was 7 in 1890 and 30 in 1900. Of the 25 cities included in his statistics, 21 have electric plants, 35 per cent. of the electrical energy being used for lighting, 24 per cent. for power purposes, and 41 per cent. for traction; the first cost of installation of those 21 stations per kilowatt capacity of station varies between $190 and $500, while the first cost of installation per kw-hour sold (during what time is not stated) varies between 17 and 80 cents; of these the number 17 refers to a Dresden station, which generates current for traction only. The system used does not seem to be of any marked influence, as far as his statistics go. In rationally-operated plants the cost of fuel is about one-half of the total true cost of operation; it is, for instance, 61.6 per cent. in Berlin, 56.8 in Frankfurt.—*Elek Zeit.*, March 13.

Wires. Wiring and Conduits.

A New Method of Wiring.—Peschel.—An illustrated paper read before the Electrotechnical Society of Berlin. The method described is to be used for a 2 x 220-volt three-wire system, the two outers are protected against contact with each other by earthed metallic tubes; the system of tubes is used as a bare middle wire. There is no danger in using a bare middle wire in houses. This is done in Stuttgart with good success. In the discussion which followed, Passavant confirmed the success of the use of a bare middle wire in Stuttgart, but remarked that in another city in northern Germany the bare middle wire deteriorated greatly; he thinks this is due to the difference of the composition of the mortar used. In Stuttgart gypsum is used mainly, while in the other city it was mortar containing lime; the corrosion is due to the electrolytic action of small currents caused by the difference of potential between the middle wire and earth.—*Elek. Zeit.*, March 6.

REFERENCES.

Pole Lines.—An article on "an extraordinary composite pole line system," giving a description of the pole line systems of the Standard Electrical Company and the Bay Counties Power Company in California, by which power will be transmitted from Colgate to San Francisco, 212 miles distant.—*Jour. of Elec.*, March.

Conduit System in Troy.—Schermerhorn.—An article on the installment of underground telephone and telegraph wires in Troy. The construction of the conduits is described.—*The Polytechnic*, March 28.

Electro-Physics and Magnetism

Temperature Variation of Electric Resistance.—Williams.—An abstract of a (Brit.) Phys. Soc. paper on "the temperature variation of the electrical resistances of pure metal and allied matters." He makes an attempt to correlate the periodic variations which the pure metals exhibit as regards their atomic weights, chemical valencies, melting points, and electric resistances. He puts this relation in the form of a mathematical formula which holds good for most of the metals, but not for all. The temperature resistance co-efficients of pure metals are not equal to 1.273, as might have been supposed; an expression for the change of resistance with temperature is deduced, which holds approximately for many metals.—Lond. *Elec.*, March 28.

Natural Earth Currents.—Jahr.—An account of the results of experiments in which he measured the natural electric currents in earth and water, at several places near Berlin. He placed two plates of cleaned metal as electrodes in the earth, at distances up to 1,000 meters, and connected them by a wire; he measured the current and the e. m. f. The greatest voltage and the greatest current were obtained, when the two plates were arranged in line with the magnetic meridian and at the angle of the magnetic inclination, so that the northern plate is deeper in the earth than the southern plate. An oxide film on metallic plates changes the current and the e. m. f. considerably.—*Elek. Zeit.*, March 6.

Magnetization of Steel at Liquid Air Temperatures.—Trowbridge.—An account of experiments in which he obtained the following results. Approximately the same magnetic moment is obtained whether a bar of tungsten steel or carbon steel is magnetized at normal or at liquid air temperature, other conditions being the same. The initial loss in the magnetic moment, due to change of temperature, of a bar of steel magnetized at 185° C., and then heated to 20° C., is much greater than when the bar is magnetized at 20° C., and then cooled to 185° C., a considerable loss occurring in both cases. There is a certain amount of unstable magnetization in a newly-made steel magnet, which tends to pass off at the first change of temperature in either direction from that at which magnetization takes place, much more of the unstable magnetization passing off by heating than by cooling.—*Phys. Rev.*, March.

REFERENCES.

Electrons.—O. Heaviside.—A mathematical "note on the size and inertia of electrons." He gives a concise review of the experimental work of various investigators; the results obtained are not in very close agreement. He points out that "it is a matter of fundamental philosophical and scientific importance to know whether an electron has mass independently of the electromagnetic inertia."—Lond. *Elec.*, April 4.

Light Absorption.—Wood.—An abstract of a (Brit.) Phys. Soc. paper describing experiments which have led him to believe that he has found a new type of light absorption which it may be possible to refer to the electric resonance of minute metallic particles for waves of light.—Lond. *Elec.*, March 28.

Terrestrial Magnetism.—The March number contains an article by Littlehales on forthcoming advances in the terrestrial magnetism of Antarctica; a paper in German, by Elster, on measurements of the electric potential drop on Spitzbergen and Juist; a report, by Bauer, on the magnetic observations made in North America during the total solar eclipse on May 17, 18, 1901; and a biographical sketch,

with portrait of Prof. Franz Exner.—*Terr. Magn. and Atm. Elec.*, April.

ELECTRO-CHEMISTRY AND BATTERIES.

Artificial Graphite and Platinum Iridium for Anodes.—FOERSTER.—An account of an experimental investigation. While natural graphite is not suitable for anodes on account of the non-uniformity of the structure and of the high percentage of ash, he formerly obtained excellent results with artificial graphite electrodes made by a French company by the Girard and Street process, and has now also found that artificial graphite electrodes made by the Acheson process are at least of the same high quality. Acheson graphite is not less porous than the French graphite; the volume of the pores of the Acheson graphite was found to be 22.9 per cent. of the total; the percentage of ash is very low, namely 0.83 per cent. Artificial graphite electrodes of Acheson were first used as anodes in a neutral 20 per cent. solution of sodium chloride, in the presence of the chromate, at a temperature of 60 per cent.; the attack of the anodes is very small; in two experiments this attack corresponded to 6.3 and 8.4 per cent. of the total ampere-hours; the percentage of carbonic acid in the escaping gases was corresponding low. This high chemical viscosity is also maintained by a graphite anode at relatively high current densities for a longer time. He then used graphite anodes in sulphuric acid; as has been known before it is not well suited for this purpose as the graphite anode is destroyed by oxidation; this destruction is not smaller than for anodes of amorphous carbon. He then used the graphite anode in sodium hydroxide; at a temperature of 20° C. the graphite anode was found to be practically indestructible. For this purpose graphite anodes are very suitable and very much superior to amorphous carbon. From all his experiments he draws the following general conclusion: "The difference in the oxidation of the graphite and of amorphous carbon is not constant, but the higher the concentration of the hydroxyl ions of an electrolyte and the lower therefore the anode potential at which oxygen is formed at the anode, the more is graphite superior to even the best amorphous carbon. At such a high anodic potential, as occurs in dilute sulpuric acid, the difference has disappeared; nearly the total oxygen formed by the current is used up for oxidation of the carbon anode." As graphite anodes are not entirely indestructible in the electrolysis of alkaline chlorides, he believes that platinum or platinum iridium is the ideal anode material for this purpose; very thin plates of this material were formerly found to break easily. Heraeus has found that this was due to ruthenium contained in the material; when this is removed, alloys of very pure platinum and iridium are very tough and firm, and can be rolled into extremely thin sheets. Such sheets are used in Heraeus platinum electrodes, the mechanical construction of which has already been described in the Digest. (See also the abstract of Denso's article).—*Zeit. f. Elektrochemie,* March 6.

Platinum Iridium Electrodes.—DENSO.—An account of long tests of platinum iridium electrodes, as made by Heraeus, concerning their chemical resistivity in the electrolysis of alkaline chlorides for a longer time. These electrodes have a thickness of 0.007 mm, and consist of a platinum iridium alloy containing 7.6 to 15 per cent. iridium. Their weight was 5 to 10 grams. In three cases a loss of 3 milligram was found; in two cases no loss whatever; in four cases losses of about 1 milligram or below. In the cases where the greatest loss was found, it was found to take place at the beginning of the electrolysis. There is no essential difference between electrodes containing 7.5 or 15 per cent. of iridium. The general conclusion of the article is, that platinum iridium electrodes rolled to thickness of 0.007 mm have sufficient chemical resistivity to be used in electrolysis of alkaline chlorides on an industrial scale.—*Zeit. f. Elektrochemie,* March 6.

Storage Battery with Constant Electrolyte.—An abstract of a patent of Michalowski. In cells of the oxygen lift type *K O H* or *Na O H* are used. He substitutes for this a solution of an alkali aluminate. When current flows through this solution it is practically not changed, if the active mass of both electrodes is insoluble in the electrolyte. The current produces *K O H*, and simultaneously acts as a reducing agent, while at the anode it forms alumina and acts as an oxidizer; when the electrodes are close together, the alumina combines at once again with the potassium hydroxide and forms the original potassium aluminate again. This electrolyte enables spongy zinc to be used as material for the negative electrode, as zinc oxide is insoluble in the aluminate solution. This makes the substitution of zinc for cadmium possible, which cannot be done in other electrolytes.—*Centralbl. f. Accum.*, April 1.

Bright Metallic Electro-Deposits.—A description of a method by Darmstaedter, for improvements in the methods of obtaining bright metallic coatings by electrolysis. Insoluble materials, such as sawdust, sand, pumice-stone, in a fine state of division, or the salt composing the electrolyte—which in this case must be saturated—are added to the bath and the contents are kept in continual movement by mechanical means. The effect of this finely divided insoluble matter, held in suspension in the liquid, is to loosen any bubbles of hydrogen clinging to the surface of the cathode, and also to act mechanically as a burnisher. The production of bright metallic deposits is said to be greatly aided by the use of this method; and it is hoped that it may be especially useful in zinc extraction. But this is doubtful, as it has not yet been proved that the formation of spongy zinc is due to hydrogen bubbles deposited together with the zinc.—*Zeit. f. Elektrochemie,* Feb. 13; abstracted in Lond. *Elec.*, April 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Modified Mance Test for Submarine Cables.—STEPHENS.—An illustrated article. The error due to earth current is eliminated in Mance's method by taking two tests to instrumental zero with different current strengths. This can be done by two methods: the first is to alter the battery power or the resistance in the battery circuit; the second is to alter the resistance in the ratio arms. Of these, the first necessitates the use of a milliammeter or galvanometer, unless testing with a battery of accumulators. The second gives a fairly simple formula for even ratios, but a complicated one for uneven ratios. There is, however, a third method of altering the current strength, namely, by the insertion of a resistance in the line circuit when taking the second test, keeping the ratio arms, battery power and resistance in the battery circuit, the same for each test. By making this resistance equal in value to that of the ratio arms, a simple and handy formula can be evolved for either even or uneven ratios, thereby ensuring greater accuracy. The formulas show that this method can be readily used as a check upon the method for the "reversals" test, or inversely. The article is discussed in an editorial note; the modified test is said to have two points in its favor: the greater simplicity of the formula and the slightly easier method of manipulation. But the first of these depends upon the added resistance being equal to the bridge ratio arm adjacent to it, and the necessity for making it so tends to limit the useful range of the current ratio. Moreover there is no provision in this class of test, when batteries with small plates are used, for ascertaining with sufficient precision that the currents used have the required values—which is important. For this reason the milliammeter method in which the actual currents are measured, and a formula used based upon precise knowledge of the true ratio, is undoubtedly the best, and is not superseding all other tests in which the calculation of the ratio is an indispensable preliminary.—Lond. *Elec.*, March 28.

REFERENCE.

Resistance of Rail Joints.—A summary, illustrated by diagrams, of various methods for measuring the resistance of rail joints.—*Elek. Anz.*, March 16.

TELEGRAPHY. TELEPHONY AND SIGNALS.

London.—The conclusion of the long illustrated article on the City Exchange of the Post Office Telephone Department; also some editorial notes. The central or common battery system is used. The exchange, when it has its full complement of 14,000 subscribers, will be one of the largest built on this or any other system. "The Post Office was well advised to adopt the most modern and efficient method of working, and if there is room for criticism, it is rather that they have adopted a system with all its details en bloc from America without attempting to modify it to suit the particular circumstances in London. . . . The peculiar circumstances would almost seem to have justified an experiment with a divided multiple board system, on lines similar to that in operation at St. Louis, for it would appear possible to combine it with the central battery and luminous switchboard system of working." While it is agreed that for long-distance working the solid back transmitter is hard to improve upon, there is is no doubt that for ordinary exchange working a hand miscrophone is by far the most convenient to the subscriber. "There is at least one pattern of this instrument which will produce excellent speaking on central battery exchanges, and it is remarkable that American telephone engineers are still partial to the fixed transmitter."—Lond. *Elec.*, April. 14.

Wireless Telegraphy.—An editorial on the commercial prospects of wireless telegraphy between Europe and America. Marconi says he can transmit at present 22 words per minute. Even when wireless telegrams would be sent continually day and night, only a small part of the present traffic could be accomplished by wireless telegraphy. The erection of several stations with a system of tuning is limited. If Marconi wants to compete in earnest with cable companies, he must send at least 6 to 10 telegrams at the same time. But as Braun has said, in this way wireless telegraphy would commit suicide, as it would prevent wireless telegraphy from ship to ship and from land to ship. Instead of trying to break the record in overcoming large distances, inventors should improve the reliability of the apparatus and cheapen them so that small vessels could be provided with them.—*Elek. Zeit.*, March 13.

New Books.

LES DECHARGES ELECTRIQUES DANS LES GAZ. By J. J. Thomson, D. Sc., F. R. S. Translated from the English, with notes by Louis Barbillon. Preface by Ch.-Ed. Guillaume. Paris: Gauthier-Villars. Price, 5 francs.

This little volume is a well done translation of Professor Thomson's English brouchure of similar title, with some valuable explanatory notes by the translator, and an interesting historical preface by M. Guillaume, giving an excellent idea of the growth of the subject. Professor Thomson's researches are well-known to our readers and are admirably presented here, as in the parent English book. They are peculiarly interesting to the French physicist by reason of the very important part which the latter have played in the development of the knowledge of what one may term *occult radiations.* The subject is one peculiarly neglected by our own countrymen, and which is deserving of close study.

Professor Thomson's work may logically be divided itno two parts —the phenomena of discharges in gas and the physical bearing of these phenomena on the constitution of matter. The former is of great practical interest, but the latter are of so profound physical importance as to demand the best energies of a host of investigators. The knowledge of occult radiations is steadily increasing, but it is still discursive, still incapable of leading to exact conclusions. More than anything else the matter needs the most persistent attacks from the chemical side. The corpuscular hypothesis, in the absence of exact or even proximate knowledge of the nature of the so-called "electrical" stresses and strains, must remain in a most dubious and unsatisfactory state until it is confirmed or confuted by researches along other than electrical lines. Moreover, chemical aid is needed in furnishing further means of investigation. In all the work on occult radiations photography takes a very important part. It is almost inconceivable from the standpoint of chemical theory that salts of silver should be the only ones really effective for such purposes. It is more than likely that for the radiations with which modern science is dealing other sensitive media can be found, capable of giving an immensely greater working range than ordinary photographic plates. Here is a line of investigation that should be pursued industriously in order to extend the available means of investigation in the lines which Professor Thomson has so brilliantly inaugurated.

ELEMENTARY ELECTRICITY AND MAGNETISM AND THEIR APPLICATIONS. By Professors Dugald C. and John Price Jackson. New York: The Macmillan Company, 1902. Pages VII, 482. Price, $1.40.

Static electricity is here briefly and tersely discussed in the opening chapters covering some 27 pages, and the topics of relative potential and potential difference are illustrated and explained in an exceptionally clear manner. A singular innovation is the employment of hydraulic analogies in explanation of the frictional electrical machine. In a modified way this was done by Lodge some years since, but in general literature these analogies have been reserved for the explanation of batteries and dynamo machinery. There are in reality no hydraulic phenomena of relatively enormous head and exceptionally minute flow which may adequately serve as an illustration of the Holtz machine, for example. This false analogy has led the authors into a discussion and definition of the ampere and the volt under the heading of static electricity, which is not only unusual, but questionable. Following this is a pleasantly written chapter on batteries in which the barest elementary principles of the voltaic cell are clearly discussed. The use, however, of the term "electrochemical depolarizer" in the action of the Daniell cell is scarcely in good form; for properly speaking such polarization is not due to the ionization of the copper; the depolarization is rather by "deposition" and is as truly a chemical phenomenon as the instances included by them under the name of "chemical depolarization." A meager description of electrolysis follows, and this is succeeded by a barely satisfactory description of the nature and properties of magnetism.

Again, in the discussion of the properties of electrical circuits, the authors are too insistent upon hydraulic analogies. To attempt an explanation of divided and series-multiple circuits by a resort to similarly connected systems of water pipes, results only in added confusion. Electrical resistance and the resistance to the flow of water in pipes have practically nothing in common, except that each causes a loss of potential. Effective hydraulic resistance is a phenomenon of skin friction and inertia. It is only fair to mention that the authors partly realize this inconsistency (page 85). Also in the discussion of the energy units of the electrical circuit hydraulic analogies can be employed correctly only when the two classes of quantities are equated through their heating effects. The failure of the authors in these respects leaves the readers with not one, but with two sets of facts for explanation.

A section embracing some fifty pages is given to galvanometry and the methods and apparatus for the measurement of electrical resistance, current, potential and power. Here the selection of apparatus is good, and the illustrations for the most part are diagrammatic and show the essential parts and their arrangement. This is a pronounced excellence and calls for strong commendation. The explanatory text is clear and even a casual reader must gain a proper material conception of arrangement and parts. But the authors go no further; and while the section is successful as mere description, it is practically valueless for imparting knowledge. As this is indicative of the character of the entire book; the work is the mere description shell of the subject, and it lacks the vital principle of the matter which it includes, and this vital spirit can only be imparted through mathematical or quantitative discussion. Without it the best written text book is nothing but a more or less entertaining catalogue of the skill of man and the wonders of Nature.

About one-half of the book is devoted to topics of elementary matters of electrical engineering proper; and as these subjects are treated in a precisely similar manner and spirit, their discussion need not be enlarged upon, though evidently the book was undertaken more especially for such discussion and description.

The proofreading appears to have been done with unusual care, but yet a most singular oversight has evidently occurred, where on page 336 the classical message of the Morse experiment is made to read, "What hath God wrought?" and the punctuation reduces the reverent exclamation to the ridiculous.

One is led immediately to compare this book with the generally popular "Lessons of Electricity and Magnetism," by S. P. Thompson. Though the present book follows this largely in method and arrangement, it fails of the very qualities which have made the other a textbook; it has the form, but has omitted the vital elements, which are the quantitative expressions of the relation of the facts in the phenomena discussed. For a text on elementary electricity and magnetism the work is inferior to the small book by Perkins; and in the discussion of the principles of mechanically generated electricity, both the student and the non-technical reader would find the series of books by Houston and Kennelly clearer and more helpful. The present authors are evidently indebted to the latter for many suggestions.

The paper, letter press and the binding are excellent, and many of the illustrations are exceptionally fine. The authors have in almost all cases shown apparatus so as to bring out its essentials of construction and operation. Great pains have been taken in the illustrations and diagrams to develop the circuits, connections and essential relations, and the result is one of unusual merit. A few illustrations are, however poor, such as Fig. 315, an ocean cable operating set; and several are badly out of proportion to the page, or, as on page 404, to other illustrations. It is a piece of affectation, too, to name an illustration as Fig. 324 is called: "Weber Photometer standing on Reading Room Table in Library of University of Wisconsin." One fails entirely to grasp the part that such a location plays as a function in the measurement of the intensity of illumination. Then, too, it would have been advisable that some skilled person should have made the drawing for illustrations of such kind as are shown

KELVIN

SUPPLEMENT TO ELECTRICAL WORLD AND ENGINEER.
APRIL 26 1902

Photograph, Copyright Falk Bros., New York City.

in Fig. 283, and thus avoid the kindergarten portrayal of a man, which is so out of place in a book generally well illustrated.

A book of this character is apt to owe its inspiration to the publisher rather than an intellectual impulse for expression of what has been developed in the thought and experience of the writer. However, the problem of writing such a book is commendable, and the present authors, while showing neither originality nor distinction, have performed their task in an interesting manner. The book is not properly an elementary work on electricity and magnetism, but it is more correctly a work descriptive of their numerous industrial applications, and it is a mistake to entitle it a textbook designed for high and manual training schools. As a book for reference it might prove useful, but as a text one is led to wonder what information, not to speak of the idea, a student would gain from such discursive lines as are to be found making up the topics of the transformer (page 261), the rotary converter (page 270), or the ballistic galvanometer (page 208), which have been selected at randon as illustrations.

A SCHOOL CHEMISTRY. By John Waddell, B. A. (Dal. Coll.), B. Sc. (Lond.), Ph. D. (Heidelberg), D. Sc. (Edin.), New York: The Macmillan Company. 278 pages, 90 illustrations. Price, 90 cents.

This is a capital school text-book of inorganic chemistry. It is very clearly written and systematically compiled. The experiments are arranged for laboratory repetition and a list of chemicals and apparatus for the experimental work precedes the text. Commencing with the elementary chemistry of water, the air, acids, alkalis, common salt, and the metals are successively considered, in a total of twenty chapters. The symbolic notation in the chemical equations shows at a glance the physical states of the substances considered, whether solid, liquid or gaseous. The metric system is, in most praiseworthy style, employed throughout, and with neither apology nor introductory tables, it being taken for granted apparently that the reader knows the meaning of such terms as litres, and grammes. To an elementary student the book will be most welcome, either for class-work, or home study if he carries on the experiments described.

BOOKS RECEIVED.

MAGNETISMO E ELETTRICITA. Hoepli Manual, 1902. By F. Grassi. Milan: Ulrico Hoepli. 608 pages, 280 illustrations.

TRANSACTIONS OF PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Fifth Annual Convention, 1901. San Francisco, Calif. 209 pages, illustrated.

THE BEACON BIOGRAPHIES. Samuel F. B. Morse. By John Trowbridge. Boston: Small, Maynard & Company. 134 pages, frontispiece portrait. Price, 75 cents.

MARSHALL'S LOGARITHMIC TABLES OF THE MEASURES OF LENGTH. By Thos. W. Marshall. New York: The Engineering News Publishing Company. 106 pages. Price, $2.00.

ELEKTROTECHNIK IN EINZEL-DARSTELLUNGEN. By Dr. G. Benischke. Heft I, Die Schutzvorrichtungen Der Starkstromtechnik Gegen Atmospharische Entladungen. Heft 2, Der Parallelbetrieb von Wechselstrommaschinen. Braunschweig: Friedr, Vieweg & Son. 42 pages, 43 illustrations; 55 pages, 43 illustrations. Price, each, 1.6 marks.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Next meeting, Pittsburg, Pa., May 22 and 23, 1902. (See Current News and Notes.)

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO TELEPHONE ASSOCIATION. Next meeting June, 1902.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

New Electric Tonneaus.

In illustrating herewith the new Waverley electric tonneau of the International Motor Car Company, of Toledo, O., we may note incidentally that, judging by the experience of this company, the mooted question as to the proper side for the operator to occupy is answered by building both styles of automobile. For instance, Waverley elec-

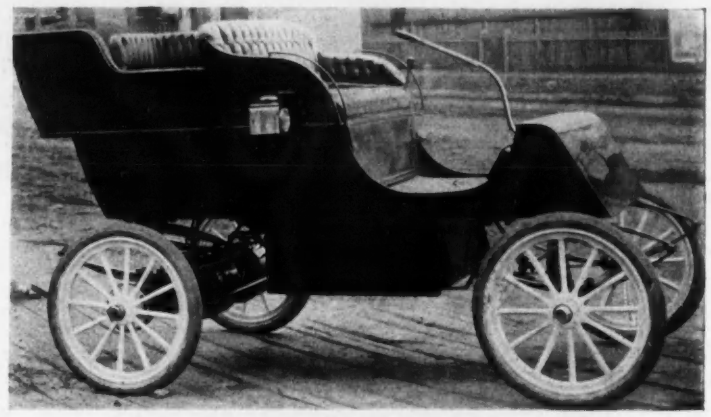


FIG. 1.—ELECTRIC TONNEAU.

tric carriages are built controlling from the left side, while Toledo steam carriages are operated from the right, and the gasoline touring cars have been built with the levers on either side to meet the requirement of different customers. The general preference is, however, to locate the operator's seat on the right, thus the control levers

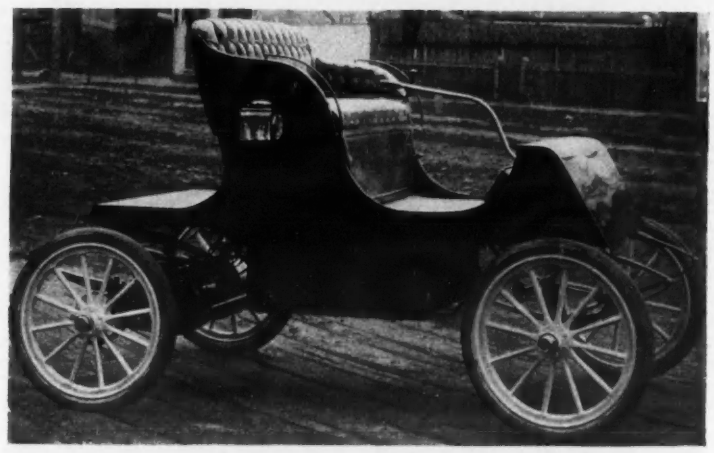


FIG. 2.—ELECTRIC TONNEAU.

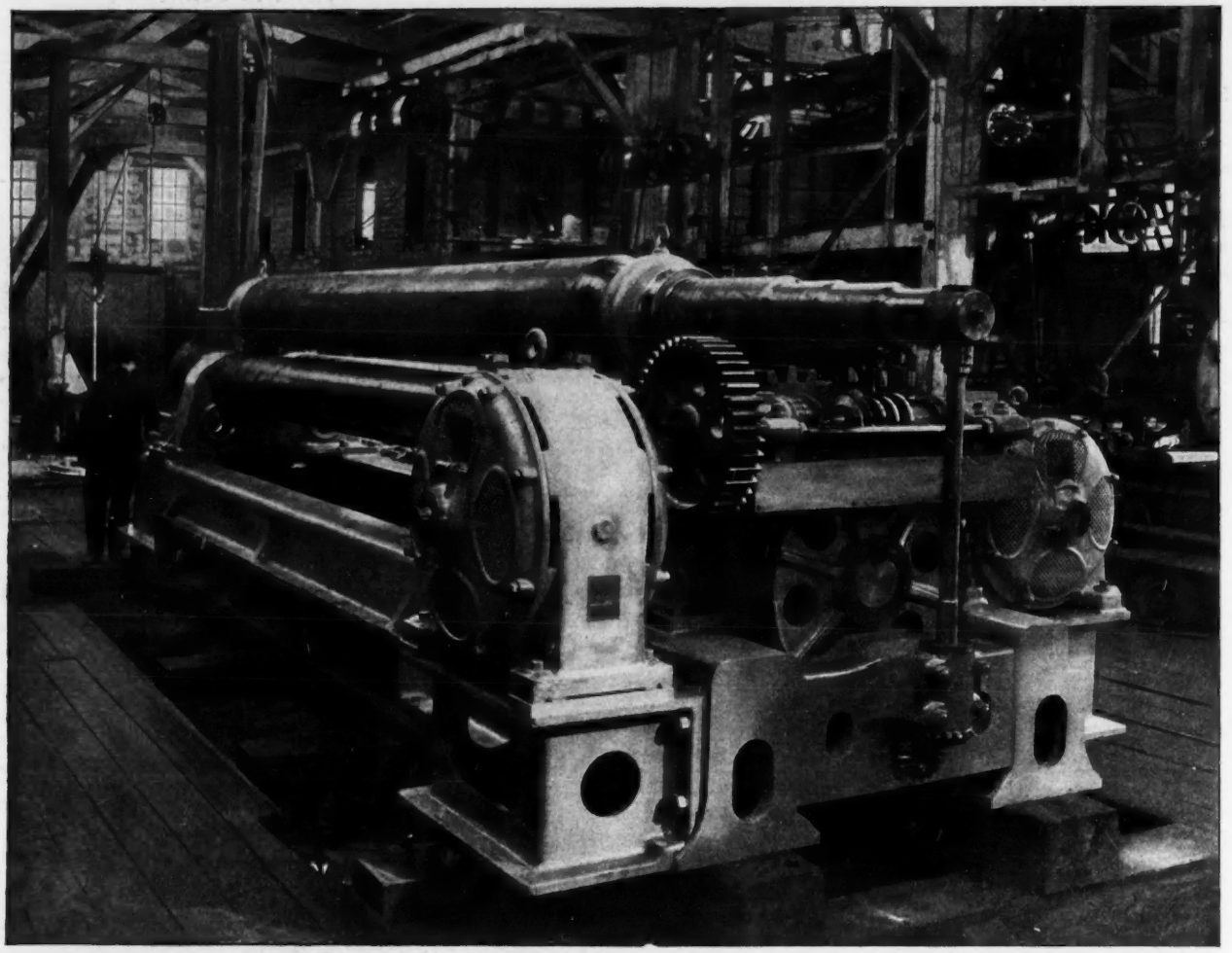
are actuated by the right hand, which certainly seems preferable for a gasoline driven car.

The new electric tonneau built by the Waverley department at Indianapolis has attracted general attention, although it was first exhibited only a month and a half ago at Chicago. The elastic

running gear, now the standard Waverley equipment, makes a great improvement in electric carriages. The novel spring suspension, doing away with the necessity for reaches, etc., relieves the vibration, and at the same time compensates for road inequalities, thus materially increasing the life of the battery and the comfort of the passengers. These improvements are opening up a new field for the automobile, adapting it to country requirements and minimizing prejudices against electric carriages for business purposes.

Motor-Driven Plate Bending Rolls.

The continental Iron Works, of Brooklyn, recently installed a new machine, designed for bending heavy plates for boiler shells. The rolls measure 16½ ft. between housings; they are three in number and are composed of steel forged at the Bethlehem Works; the top roll, which is the idler, weighs 10 tons, and measures 21 in. in diameter. while the two lower rolls, which are operated, are each 17 in. in diameter. This machine was built by the Continental Iron Works for their own shops, to meet requirements of a special character in unusually heavy work, and it was designed by Mr. Warren E. Hill, the vice-president and general manager of the company. In order to insure a sufficient factor of safety the plans were drawn upon a basis providing a capacity for bending a 16-foot plate 1½ in. in thickness intoa cylinder 5 ft in diameter. In actual practice the machine bends ⅞-inch plates, and it performs its work with the utmost smoothness and regularity.



Motor-Driven Bending Rolls.

In general appearance these rolls resemble others intended for similar work, but they embody several distinctive features. Although these rolls are very heavy and powerful, they are very compact, and the gearing is so designed and arranged as to occupy comparatively little space. This feature is clearly illustrated in the accompanying cut, which is an end view, showing the frame on which the motors are mounted, and the arrangement of the driving-gear. The motors are Westinghouse variable-speed, and develop 40 and 50 hp respectively. The larger motor drives the two lower rolls, and the smaller motor is employed to raise and lower the top roll. Both of these movements are regulated to a nicety. The motors take polyphase current at 220 volts, 60 cycles, and are controlled by an operator stationed on a platform above the motors and gearings. By means of levers the operator regulates the speed and direction of motion of the motors, and the raisinig and lowering of the rolls, so that a wide range of speeds may be had. A feature of this equipment that commands itself especially is that very little attention is required by these motors; they are easily regulated and respond quickly to the varying demands for power as well as the variation in speed, and the regulating mechanism is positive in action. The speed is greatly reduced by the gearing; that of the driving mechanism being brought down to 840 revolutions per minute, at the motor to 3⅜ turns to the rolls.

The top roll has an extension, shown in the cut, which plays an important part in the operation of the tool, by exerting a counter-strain when plates are being adjusted or unshipped. A vertical rod is connected to this tail-piece, and is employed to adjust the position of the upper roll and to lift it when unshipping.

It has already been mentioned that these rolls were intended for heavy work, and that they were designed to bend a plate in cylindrical form. It is necessary in such work to have a convenient arrangement for unshipping the shell, after it has been bent, from the end farthest from the gearing and driving mechanism, and to meet this requirement it was deemed advisable to design a special end-bearing for the upper roll that could be easily removed, at the same time providing for keeping the free end of the roll entirely clear of contact with the lower rolls. This special end-bearing was designed to be readily unlocked and slipped off the roll, and then lowered until it is entirely out of the way, thus permitting the cylinder to be withdrawn; when the shell has been removed this end piece is raised to its former position, slipped back over the end of the roll, locked in place, and the machine is ready for operation again. The lowering and raising of the end piece is controlled by hydraulic power. While this end piece is withdrawn, the upper roll usually sags a couple of inches, but the counter strain is provided for at the other end, and the form of the free end is such that the supporting piece can be readily slipped back without any difficulty whatever.

Automatic Telegraph Repeater.

The instrument illustrated herewith has just been brought out by Messrs. J. H. Bunnell & Co., New York. Its principal advantages, as pointed out by the firm, are that it requires no extra local batteries, no extra local magnets, and is as simple in its construction and operation as the time-honored button repeater.

The two illustrations show the transmitter in perspective, and a diagram of the circuits. The principle involved in the new apparatus is that an armature on being drawn towards a magnet becomes itself magnetic by induction, and that the closer it approaches the

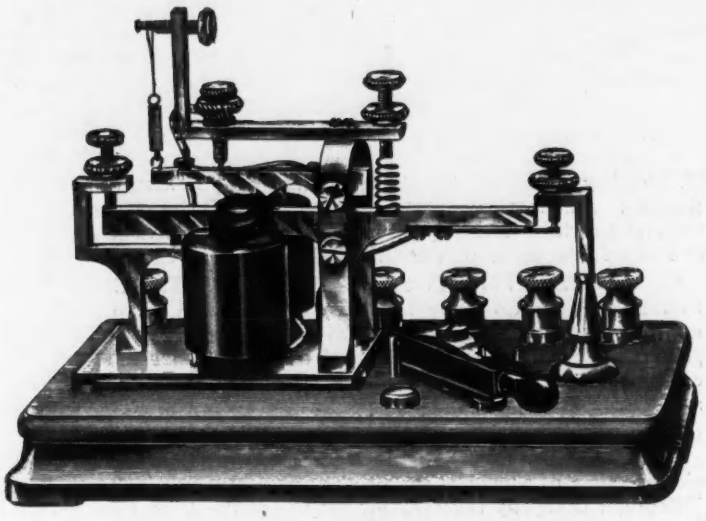


FIG. 1.—AUTOMATIC TELEGRAPH REPEATER.

magnet cores the stronger the magnetization becomes. It will be noticed that besides the ordinary armature with spring contact, the transmitter is provided with a second armature mounted above the regular one. The lever of this second or superposed armature also carries a spring contact so arranged that it makes contact with its back stop the instant that the armature begins its upward movement, and does not break contact therefrom until its downward stroke is almost completed; so that with two circuits connected to the contacts of the transmitter armatures one of them is always closed before the other is opened, by the movements of the armatures.

The second armature is adjusted so that on closing the local circuit of the transmitter the regular armature must reach its front stop before the magnetization induced in it is sufficiently powerful to draw the second armature from its back stop. The object of this

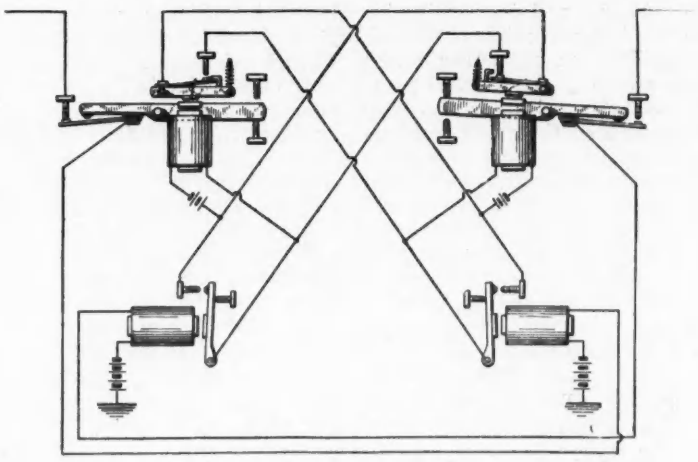
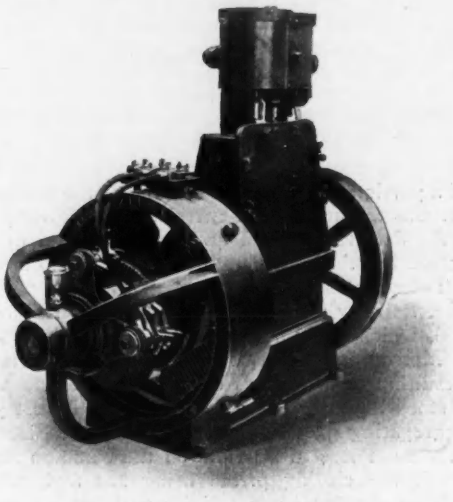


FIG. 2.—DIAGRAM OF REPEATER CIRCUITS.

is to allow a sufficient margin of time between the closing of the main circuit by the downward movement of the first armature, and the opening of the shunt circuit by the subsequent downward movement of the second armature, to permit a relay in the main circuit to close its local contacts before the shunt circuit around them is opened. This margin of time between the closing of the main circuit and the opening of the shunt circuit enables these repeaters to work well even on leaky lines, under which conditions the relays usually act sluggishly.

New Marine Generating Set.

The marine generating set shown in the accompanying cut has been designed to meet a demand for a small and compact outfit, extreme lightness being especially desired. Aluminum is used very extensively in the construction in portions where great strength is not required. The dynamo is of the multipolar type, the ring and



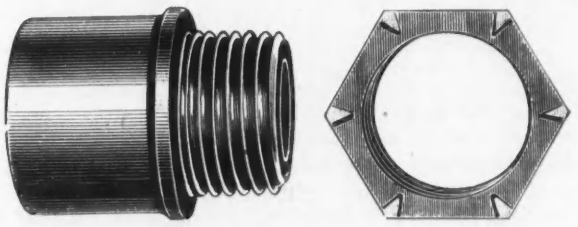
MARINE GENERATING SET.

poles being of a grade of wrought iron selected on account of its high permeability. It is reduced in weight to as great an extent as can be done without interfering with the efficient performance of the machine.

The armature is of the drum-wound type and well laminated. It is mounted upon the engine shaft. The brush holders are of the radial type, such as are used on all Holtzer-Cabot motors. Self-oiling and self-aligning bearings are used. In the cut the dynamo is shown in direct connection with a Herreshoff engine of a recent type, which has been brought out especially for this class of work. It is of the slide valve type, with throttling governor. It will be observed that all working parts are completely enclosed and run in oil. This set weighs about 298 lbs., and will supply 30 16-cp lamps or 5 watts sets is being manufactured by the Holtzer-Cabot Electric Company, of Boston, Mass.

Outlet Bushing.

The outlet bushing, illustrated herewith, and manufactured by S. B. Condit, Jr., & Co., Boston, Mass., is said to thoroughly ground a conduit system to the outlet boxes. It has the advantage that the



OUTLET BUSHING.

conduit need not necessarily be cut to the exact length where it enters a box, as the bushing fulfills the part of a coupling. On the lock-nut the points or projections are sharp, and where the nut is screwed up tight the lock washer cuts itself into the box and makes a reliable electrical connection, at the same time springing enough to lock itself firmly in place.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a good supply of money and a moderate business, the closing rates being 4 per cent. for 30 to 60 days, 4¼ per cent. for 90 days and 4½ per cent. for four, five and six months. On the stock market there was greater activity in speculation. One of the prominent incidents of the week was the reduction of the quarterly dividend on Amalgamated Copper from 1 per cent. to ½ per cent., although this result has been generally expected, and in spite of very unfavorable talk about the stock and the copper situation generally, the covering of shorts caused a moderate improvement in the price. United States Steel stocks were quiet and firm pending the carrying out of the bond issue and the retirement of a portion of the preferred. One of the sensational features of the week was the advance in International Power stock from 107 to 163 on the declaration of a quarterly dividend of 2½ per cent. In the traction list there was nothing specially noteworthy—Brooklyn Rapid Transit closing with a net gain of 1½ points, and Manhattan Street Railway with a net loss of ½ point. The former stock closed at 66, which is within ½ point of the highest figure of the week, and Metropolitan at 153. There was a reaction in General Electric, resulting in a net loss of 8 points, the closing price being 323. This stock fluctuated between 322¾, the lowest point, and 330, the sales aggregating 4,300 shares. Westinghouse Electric also closed weaker, with a net loss of 4 points on the common and ½ point on the preferred, the closing prices being 222 and 226, respectively. Western Union showed some activity and made a net gain of 3¾ points, closing at 94¼. American Telephone and Telegraph dropped off 5 points, closing at 179, and American Telegraph and Cable gained 4 points, the closing price being 92. There was a slump of 12¼ points in Commercial Cable, which kept at 152 throughout the week, closing at that figure. Following are the closing quotations of April 22:

NEW YORK.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
American Tel. & Cable..	88¼	93	General Electric.....	329	326
American Tel. & Tel....	180	—	General Carriage.....	¾	—
American Dist. Tel.....	—	—	Hudson River Tel.....	—	—
Brooklyn Rapid Transit..	65	66¾	Metropolitan Street Ry..	153	152
Commercial Cable.....	152	—	N. E. Elec. Veh. Trans..	1	—
Electric Boat.....	26½	30	N. Y. Elec. Veh. Trans..	12	12¼
Electric Boat pfd.....	45	49	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1⅜	1⅜	Tel. & Tel. Co. America..	4½	4½
Electric Vehicle.....	3¼	3⅜	Western Union Tel.....	90½	92⅝
Electric Vehicle pfd.....	7¼	6⅜	West. E. & M. Co.....	—	227
			West. E. & M. Co. pfd..	—	—

BOSTON.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
American Tel. & Tel....	180	178	Mexican Telephone.....	2½	2½
Cumberland Telephone...	125	—	New England Teleph....	149⅜	149⅞
Edison Elec. Illum.....	272	—	Westinghouse Elec.....	111½	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	112½	—
General Electric pfd....	329⅝	—			

PHILADELPHIA.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
American Railways.....	44¼	47	Phil. Traction.....	98	98
Electric Storage Battery..	77½	81⅞	Philadelphia Electric.....	5¼	5½
Elec. Storage Batt'y pfd.	77½	—	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7⅞	7⅜	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Apr. 15.	Apr. 22.		Apr. 15.	Apr. 22.
Central Union Telephone.	—	—	National Carbon pfd.....	*89	89
Chicago Edison.....	175	168	Northwest Elev. com....	—	—
Chicago City Ry.....	*220	220¼	Union Traction.....	20⅞	21¾
Chicago Telep. Co.....	—	—	Union Traction pfd.....	—	58
National Carbon.....	20¾	24⅛			

*Asked.

THE SAFETY INSULATED WIRE AND CABLE COMPANY was incorporated at Trenton, N. J., last week, with a capital stock of $1,500,000. There will remain in the treasury of the company $500,000 of the capital stock and $1,000,000 of an authorized $1,250,000 first mortgage 6 per cent. sinking fund gold bonds will be issued, the balance being also left in the treasury, not to be used except to acquire additional property or working capital. A submarine cable for a foreign government is now in course of construction by the company, and other foreign contracts are pending. Other details have already been given in these columns.

LOUISVILLE GAS AND ELECTRIC.—It is understood preliminary arrangements have been completed for the amalgamation of the Louisville Gas Company, the Kentucky Heating Company and the Citizens Electric Company. The Louisville Electric Company goes with the Louisville Gas, which owns all the stock. The city owns $1,000,000 of stock in the gas company. When satisfactory terms are arranged for the sale of this stock, a definite arrangement will be made. It is understood the Louisville City Railway will ultimately be taken into the combination, and the majority control of the stock is already being secured.

CONSOLIDATION AT ATLANTA.—The Mercantile Trust Company of Baltimore, Md., and New York and Boston capitalists have completed the merger of all the street railways and light and power interests of Atlanta, Ga., by the organization of the Georgia Railway & Electric Company, which will have the following capitalization: First mortgage 5 per cent bonds, $7,850,000; preferred stock, $1,800,000; common stock, $5,000,000. The company will absorb the

INTERNATIONAL POWER.—Directors of the International Power Company declared a quarterly dividend of 2½ per cent. on the common stock in addition to the 6 per cent. on preferred. Mr. J. H. Hoadley authorizes the statement that his purchase of the New England Vehicle Company ,of Boston, and of the charter of the General Carriage Company, has been for his own personal account, and not for account of the International Power Company.

CONSOLIDATED STORAGE BATTERY.—The Consolidated Storage Battery Company has been chartered, at Trenton, N. J., with a capital of $10,000,000, to deal in electric motors of all kinds, pneumatic, chemical and mechanical machinery, and the like. Incorporators are: Frank H. Lord and George T. Holmes, New York, and Oscar L. Gubelman, Jersey City. Two-thirds stock and not two-thirds stockholders will control company's affairs.

NEW ENGLAND TELEPHONE AND TELEGRAPH.—A special meeting of stockholders of the New England Telephone and Telegraph Company is called for May 5, at the New York office of the company, to act upon the recommendation of the directors that the capital stock of the company be increased from $20,000,000 to $30,000,000. The annual meeting of the company will be held upon the same date to elect directors.

WASHINGTON CAPITAL TRACTION COMPANY.—The annual report of the Capital Traction Company, of Washington, D. C., shows: Gross earnings, $1,231,683; operating expenses, $560,171; net earnings, $671,512; total net, $691,189; surplus after charges and dividend (4 per cent), $99,389.

Commercial Intelligence.

THE WEEK IN TRADE.—According to trade advices received by the mercantile agencies, the weather conditions have not been altogether favorable for prices of staples on the exchanges, and distribution of merchandise through regular channels. Continued low temperatures and dry weather have lessened confidence in the winter wheat yield, and prices of provisions of all kinds have been advanced, ostensibly and apparently because of reduced receipts. The basic features in general industry, however, remain favorable. Earlier reports of good trade and large distribution of merchandise are confirmed by the gross earnings of railways for the first week in April, showing an increase of 6.5 per cent., over the same period a year ago, and less than 15 of the roads reporting, note decreases. February net returns are equally favorable, showing an increase in gross receipts of 4.8 per cent., and in net, 2.4 over last year, and this in a month notable for bad weather and interruption of traffic. In iron and steel, production and consumption are apparently at a maximum. Pig iron is quoted at $1.00 per ton higher than a week ago, the demand for scrap material improving as a consequence. The carriage of Lake ore this year is estimated at 22,000,000 tons, the transportation of 75 per cent. of which has already been arranged for. Hardware and builders' materials are in very active demand. The number of business failures during the week, as reported by Bradstreet's, was 193, as against 182 the week previous, and 212 the same week last year. Trading under the standard copper contract was inaugurated at the New York Metal Exchange during the week, and it resulted in a comparatively active business in copper, the trade showing an interest in the movement. The closing quotations were 12⅛c. for Lake; 11⅞c. for electrolytic and 11¾c. for casting stock.

WIRE FOR THE ST. LOUIS FAIR.—The American Steel and Wire Company has secured the contract to furnish waterproof and rubber covered wire for the electric distribution at the World's Fair.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended April 4: Antwerp—1 pkg. machinery, $35; 10 pkgs. material, $1,006. Amsterdam—1 pkg. machinery, $108. Argentine Republic—3 pkgs. material, $146. Bremen—5 pkgs. material, $1,030; 5 pkgs. machinery, $220. British Possessions in Africa—1 pkg. material, $46. Bilboa—1 pkg. machinery, $50. British East Indies—26 pkgs. material, $2,433. Brazil—159 pkgs. material, $5,671; 18 pkgs. machinery, $930. British West Indies—32 pkgs. material, $661. Cuba—50 pkgs. material, $913. Central America—18 pkgs. material, $730. Dundee—1 pkg. material, $22. Ecuador—2 pkgs. material, $36. Genoa—29 pkgs. machinery, $2,500; 1 pkg. material, $16. Glasgow—1 pkg. machinery, $77. Hamburg—45 pkgs. material, $750. Havre—29 pkgs. material, $13,858; 20 pkgs. machinery, $295. Konigsberg—1 pkg. material, $50. Liverpool—305 pkgs. machinery, $30,993; 16 pkgs. material, $606. London—299 pkgs. machinery, $14,875; 192 pkgs. material, $7,802. Mexico—22 pkgs. material, $420; 26 pkgs. machinery, $10,000. Manchester—2 pkgs. machinery, $528. Newfoundland—60 pkgs. material, $505. Newcastle—10 pkgs. machinery, $764. Nova Scotia—3 pkgs. machinery, $130. Peru—37 pkgs. material, $2,072. Rotterdam—3 pkgs. material, $160; 5 pkgs. machinery, $1,436. Southampton—2 pkgs. material, $1,312; 1 pkg. machinery, $25. Santo Domingo—7 pkgs. material, $162. U. S. Colombia—10 pkgs. material, $150; 4 pkgs. machinery, $325. Venezuela—205 pkgs. material, $1,203.

RAILWAY EQUIPMENT.—E. P. Roberts & Co., Cleveland, O., consulting engineers for the Muncie, Hartford & Ft. Wayne Railway Co., have recently closed all contracts for the entire equipment of the line as follows: OO trolley wire, National Conduit & Cable Company; brackets and insulators, Ohio Brass Works; aluminum transmitters and feed wire, Pittsburg Reduction Company; high-tension insulators, Fred M. Locke; ties, Union City Lumber Company; poles, The Valentine-Clark Company; bridges, Indiana Bridge Company; interurban cars, John Stephenson Company; trucks, Peckham Mfg. Company. The power equipment will consist of two 500-kw. three-phase, 25-cycle revolving field, general electric generators, direct-connected to cross-compound condensing Cooper- Corliss engines. There are three Stirling 300-hp boilers, equipped with Jones underfeed stokers; space being provided for another set of similar capacity. The rotaries in the station are to be two 400-kw. and two 200-kw. capacity are to be used in substations. Four 50-hp G. E. motors will be used on the cars.

LIGHTING PLANT FOR A SULTAN'S PALACE.—The palace of the Sultan of Linga, who rules over a small island of the same name in the Malay Archipelago, is to be installed with a complete electric lighting plant of Yankee manufacture. The Crocker-Wheeler Company, of Ampere, N. J., has secured an order for a 30-kw generator for direct-connection to a 40-hp high-speed automatic engine, built by the Ames Iron Works, of Oswego, N. Y. There will also be an Ames horizontal tubular boiler of the same horse-power. The Ames people have also been alloted an order for a 100-hp high-speed engine, which is to be direct-connected to a 50-kw. motor, manufactured by the Sprague Electric Company, of 527 West Thirty-fourth street, New York City. This outfit is intended to serve as equipment for an electric light plant at Singapore, Straits Settlements. These contracts were placed in the United States through the instrumentality of the American electrical engineering and contracting firm of Bagnall & Hilles, from that concern's Singapore offices.

CROCKER-WHEELER CRANE EQUIPMENTS.—This company reports a very satisfactory increase in the demand for its crane motors and equipments. Several new sizes have lately been added to this line, which is now in such shape as to supply machines of from 1 to 60 hp. The various types are designed to fulfill the several crane applications which call for trolley, bridge and hoist work. The following recent shipments from the works at Ampere, N. J., show the variety of outputs that have been ordered in the past few weeks: 4 motors, 50-hp output; 11 motors, 30-hp output; 25 motors, 15-hp output; 4 motors, 10-hp output; 11 motors, 7½-hp output; 14 motors, 2½-hp output.

ELECTRICAL DEVELOPMENT IN PARAGUAY.—Mr. Wm. Mill Butler, general manager of the Paraguay Development Company, Witherspoon Building Philadelphia, has secured a 25-year franchise from the government of Paraguay, for an electric-lighting plant in the city of Asuncion, which has a population of over 50,000. The city has also contracted for 200 city arcs, at $172 per year for ten years, with an agreement to renew the contract at the expiration of that time, the payments being guaranteed by the National Government. It is also the intention to lay down an electric railway with rotary converter substations. Mr. Butler is vice-consul of Paraguay, in Philadelphia.

NEW GENERAL ELECTRIC LYNN FACTORY.—It is stated that the General Electric Company has purchased 100,000 feet of land adjoining its present Lynn factory, on which it will erect a structure three stories in height, 80 x 250 feet. Motors and instruments will be manufactured in the new building and will give employment to 2,000 additional hands. The company at present employs 5,000 hands, and this increase will give it a working force of 7,000. Additions will also be made to the river works and the company will have a weekly payroll of $50,000. The company owns more than 35 acres of land in Lynn, besides many large factories.

PITTSBURG TRANSFORMERS FOR HOLLAND.—The Pittsburg Transformer Company, of Pittsburg, Pa., is shipping its specialties to Kopmann & Co., of Amsterdam, Holland, through its managers for foreign sales, the Goudey-McLean Company, of 88 Maiden Lane, New York City. The Pittsburg concern has opened a New York office under the management of A. H. Mustard, formerly of the Wagner Electric Manufacturing Company. The new office, which is located in the Beard Building, 120 Liberty Street, will take care of business in New York, Northern New Jersey and the Northeastern States.

FOR MANILA POLICE TELEPHONE AND FIRE ALARM SYSTEMS.—Several orders for various material, which is intended to be utilized in the construction of the police telephone and fire "alarum" systems in Manila, have recently been placed, through the A. J. Coffee Company, of San Francisco. The John A. Roeblings' Sons Company, of Trenton, N. J., have been allotted an order for 75 miles of insulated wire, and the American Electrical Works, of Providence, R. I., are to supply about the same quantity. A fair-sized order for insulators has been placed with the Western Electric Company.

BALL ENGINE ORDERS IN CHICAGO.—An electric power plant will be installed in the building on the southeast corner Washington and Peoria Streets, Chicago. The Ball Engine Company, Erie, Pa., furnishes the engine, which will be direct-connected to a Western Electric generator. The Ball Engine Company is also installing two horizontal cross-compound direct-connected engines, aggregating 1,200-hp, in the power plant of the Chicago University.

ST. LOUIS EXPOSITION CONDUITS.—Mr. Henry Rustin, the chief mechanical and electrical engineer, informs us that the Exposition has just closed a contract for six hundred thousand lineal feet of three-inch pump log conduit with the St. Louis Refrigerator and Wooden Cutter Co., of St. Louis. This will be used to supplement the 4,200 feet of wooden subway in the distribution of electric wires about the Exposition grounds.

ALUMINUM WIRE.—The Pittsburg Reduction Company has recently sold 21 miles of aluminum wire to the Lewiston & Auburn Electric Company, for the transmission of electric power. It has also sold 20 miles of aluminum wire to the Boston & Maine R. R., for use at Concord, N. H. Electric light companies are now using it, the Boston Electric Light Company having recently ordered 100,000 pounds.

CALIFORNIA EQUIPMENT.—The Stanley Electric Manufacturing Company has closed contracts with the Valley Counties Power Company for two 2,000-kw generators, for the new generating station which will be built to utilize the water rights acquired from the Cherokee Mining Company in Butte County, Calif. Step-up and step-down transformers are included in the contract.

STORAGE BATTERIES FOR YOUNGSTOWN, OHIO.—The Cleveland office of the Electric Storage Battery Company of Philadelphia has secured a contract from the Mahoning Valley Railway Company, of Youngstown, for a storage battery equipment, consisting of 264 cells, regulating booster and switchboard, to be installed in the Youngstown power house of the company.

SHAWINIGAN FALLS PLANT.—The Dayton, O., Globe Iron Works have just received an order from the Royal Aluminum Company at Shawinigan Falls, Quebec, for a third turbine unit, to be installed at the Falls. It will consist of one pair of 59½-in. wheels, guaranteed to develop 3,200 hp under 125 feet head, making their total installation 9,600 hp.

FIRE ALARMS IN GERMANY.—U. S. Consul-General F. H. Mason, of Berlin, reports that the Gamewell Fire-Alarm Telegraph Company, which exhibited at the firemen's exposition in Berlin last summer, is putting in a full equipment for the city of Hanover, and will probably establish a branch office in Berlin.

BUCKEYE ENGINE WORKS.—The charter of the Buckeye Engine Works, Salem, Ohio, has been changed from Ohio to New Jersey and the capital stock increased to provide for extensive improvements. The personnel of the company remains as heretofore.

BIDS FOR EQUIPMENT.—The Union Block Company, Anderson, Ind., is advertising for bids on boilers, engines, pumps, dynamos, two freight and three passenger elevators, for its new block. Contracts will be closed in about two weeks.

ST. LOUIS FAIR SUBWAYS.—The contract for the construction of the electric subway at the World's Fair, St. Louis, has been awarded to the Barwick Construction Company.

ELECTRICALLY-DRIVEN TOOLS FOR INDIAN RAILWAY SHOPS.—The Lillvoah Carriage and Wagon Shops, of the East India Railway, are to be equipped with a number of American wood-working machines, to be driven by motors. The contract was secured by the J. A. Fay & Egan Company, of Cincinnati, through its London representatives, the Projectile Company, Limited. The Cincinnati Milling Machine Company, of Cincinnati, has also secured an order for its specialties, to be installed in Indian railroad shops. This order was obtained through Charles Churchill & Company, Limited, whose manager-director, Mr. Charles Churchill, it will be recalled, is now in the United States. The introduction of American labor-saving devices into British India is of comparatively recent date. Manufacturers seeking to secure such contracts, not only for tools but for electrical machinery, should be represented in London, as most of the big Indian Railways have their head offices in the British metropolis. Regarding the interview with Mr. Charles Churchill, which appeared in the last issue of the ELECTRICAL WORLD AND ENGINEER, it would be well to state that the contracts for various American machine tools, etc., for the British Government Arsenal, at Woolwich, and the London Mint, were placed with his firm as a British firm. The company is registered under the English Limited Liability Acts, and has been chosen as contractors, among others, of machinery, etc., to the British Government. Though the concern handles American machinery exclusively, the British authorities have no official knowledge of the fact. The Churchill catalogue is on file in the various purchasing departments of the government, and the order is sent for such and such a machine at such and such a price. No American machinery firm is on the British Government purchasing lists, and it would be impossible, apparently, for an American concern to get a direct order from the English authorities. This rule applies to all foreign firms. Should the Government officials find that a machine of foreign make be essential for a particular purpose, arrangements are usually made with an English concern to acquire the English patents and manufacture the specialty in Great Britain, as in the case of the Belleville boiler, with which several of the British men-of-war are equipped. The boiler is a French invention, and arrangements were made by the Admiralty for its manufacture by a London marine engineering firm.

PLANT FOR SOUTH AFRICA.—Contracts have been awarded recently for a complete electric power plant including the buildings and a refrigeration plant for the De Beers Explosives Works, Cape Town, Africa. The generating units consist of three 300-kw Parsons steam turbines, with their electric generators and exciters. There are over 1,000 horse-power of three-phase induction motors throughout the works. The boilers are equipped with mechanical stokers, coal and ash handling apparatus, fuel economizers, and induced draft. They furnish superheated steam to the turbines, which are operated condensing with surface condensers and cooling towers. The engine room also contains a large air compressor, steam-driven, and a smaller one motor-driven. The refrigeration plant contains two 50-ton compressors, motor-driven. The power house building is of brick with steel roof trusses. C. A. Parsons & Co., Newcastle, England., furnishes the turbines and generators. Sherriff, Swingley & Co., New York and Johannesburg, furnish the boilers and mechanical draft, traveling crane, etc. Fraser & Chalmers, of London, furnish the coal and ash handling plant, air compressors and building. C. A. McDonald, Chicago and Cape Town, furnish the refrigeration plant. Ledward & Co., London, furnish the condensing plant. The contract cost of the entire plant is £43,776. Mr. H. H. Humphrey, of St. Louis, Mo., prepared the plans and specifications.

SALES OF IDEAL ENGINES.—A. L. Ide & Son, Springfield, Ill., report the following recent sales of Ideal engines: One 14—22 x 16 d. c., Northern Pacific R. R., Livingston, Mont.; two 24 x 20 belted, Ashland Iron & Steel Co., Ashland, Wis.; one 15 x 14 d. c., Mich. Soldiers' Home, Grand Rapids; one 18 x 16 d. c., Manhattan Light, Heat & Power Co., St. Paul; two 12—18 x 14 d. c., W. H. Schott, Chicago, for the Illinois Hospital for Incurable Insane; two 15—22 x 16 d. c., A., T. & S. F. R. R., Albuquerque, N. M.; one 11—18 x 14 belted, Champion Copper Co., Painesdale, Mich.; one 17 x 16 belted, City of Harrisburg, Ill.; one 14 x 14 belted, City of Altamont, Ill.; one 13 x 12 belted, Arnold Electric Power Station Co., Chicago, for C. & A. R. R., Springfield; one 11—18 x 14 d. c., Bingham Consolidated M. & S. Co., Salt Lake; one 14 x 14 d. c., The Ogemaw Co., Bay City, Mich.; three 14 x 14 d. c., Hecla Coal & Cement Co., Bay City, Mich.; one 15 x 14 belted, University of Wisconsin, Madison, Wis.; one 13—22 x 16 d. c., Michigan Alkali Co., Wyandotte, Mich.; two 13 x 12 belted, Allis-Chalmers Co., Chicago, for Mexico; one 10—16 x 12 belted, Leland Stanford University, Palo Alto, Cal.; two 16 x 16 belted, C., B. & Q. R. R. Shops, Deadwood.

ALLIS ENGINE SALES.—Following are some of the principal sales of the Allis-Chalmers Company during the month of March: Virginia Electrical Railway and Development Company, Richmond, Va., one 20-in. and 40-in. x 42-in. steeple compound direct-coupled Reynolds-Corliss engine; The Milwaukee Electric Light and Railway Company, Milwaukee, two 28-in. and 60-in. x 48-in. vertical cross-compound direct-coupled Reynolds-Corliss engines; Fond Du Lac Street Railway and Light Company, Fond du Lac, Wis., 20-in. and 40-in. x 48-in. 1890 frame cross-compound direct-coupled Reynolds-Corliss engine; Twin City Rapid Transit Company, Minneapolis, Minn., 46-in. and 94-in. x 60-in. vertical cross-compound direct-coupled Reynolds-Corliss engine (second order); Richmond Passenger and Power Company, Richmond, Va., one 18-in. and 36-in. x 48-in. 1890 frame cross-compound direct-coupled Reynolds-Corliss engine.

LIGHTING PLANT FOR COREAN MINE.—The Oriental Consolidated Mining Company, incorporated some time ago under the laws of the State of West Virginia, with a capital of $5,000,000, for the purpose of acquiring a number of gold mining properties in Corea, has just placed a contract through the Allis-Chalmers Company for an outfit to light an 80-stamp mill, which the latter concern is furnishing. The equipment will be supplied by the General Electric Company. Though it will only be a 200-light plant, it is expected that the other mills of the Orient Company, which aggregate 160 stamps, will be electrically lighted in the near future. The order just placed will mark the first introduction of an electric lighting equipment into Corea for the mining regions. The New York offices of the company are at 38 Broad Street.

GOULD STORAGE BATTERY PLANTS.—Among the recent contracts secured by the Gould Storage Battery Company, is a "floating" battery of 245 cells for the Uniontown station of the Pittsburg, McKeesport and Connellsville Railway Company, Pittsburg, Pa. This installation is of 171 kilowatts, and is to be used as a floating battery on the present direct-current equipment. It will ultimately be increased by the addition of 60 cells, with a plate capacity of 212 kilowatts and a tank capacity of 318 kilowatts, when it will be used in connection with rotary transformer station. This is the first plant of seven to be installed by the Pittsburg, McKeesport & Connellsville Railway Company, which will eventually use alternating current with rotary transformer substations.

ELECTRICAL DEVELOPMENT IN NICARAGUA.—The Safety Electric Manufacturing Company, of New Orleans, La., has secured a contract for installing a 600-hp, 2,300-volt, two-phase plant at Managua, Nicaragua, which in addition to lighting will supply power for the waterworks company and other motors to be installed. Bullock alternators and Skinner engines will be used. It is expected that within a short time the Tipitapa Falls, 20 miles distant from Managua, will be developed for lighting and power purposes. About 2,500 horse-power will be generated and transmitted at 15,000 volts to Granada, Masaya and Managua. The latter plant is to be finished within a year and a half, when the steam plant about to be installed in Managua will be removed to Leon, 50 miles distant.

THE SPRAGUE ELECTRIC COMPANY has found it necessary to move its Boston office into new and larger quarters to enable it to handle the increasing business in the New England district, and has taken a suite of offices in the Weld Building, 176 Federal Street, which is one of the most desirable office buildings in Boston. The location is extremely good and is convenient to the South Terminal Station, which is almost opposite. The tenants include many well-known firms and engineers. Mr. H. C. Farnsworth continues as manager of the Boston office. He has recently added to his staff Mr. George D. Simmons, who was formerly superintendent of the Hawks Electric Company.

ST. LOUIS WORLD'S FAIR.—The contract for the erection of the Machinery Building has been awarded to Smith & Eastman, for $496,957. This building will house the big electric light and power plant to be put in by the Westinghouse Electric and Manufacturing Company, consisting of four 2,000-kw units, together with a switchboard 107 feet long, from which electrical energy will be distributed to all parts of the grounds. The distribution wires from the board will reach the subway through two towers, each 8½ x 18 feet. These towers will be fire-proof. The building will be traversed by an electric crane.

FOR ELECTRIC AMBULANCES.—Several large gifts have just been made to the Mount Sinai Hospital, in New York City, to establish and maintain an electric ambulance service. Murry Guggenheim, one of the directors, has given the largest sum, which is $20,000. The income of this is the nucleus of a permanent fund to be used when the hospital moves into its new building, at 100th and 101st Streets, between Fifth and Madison Avenues. Henry R. Ickelheimer has given an ambulance to the hospital, and Jefferson Seligman has signified his intention to pay for the maintenance of an ambulance as long as the hospital remains in its old quarters.

GENRRAL ELECTRIC CO. has had a large but brief strike at its Schenectady works, arising from a dispute in the polishing department, as to piece-work.

General News.

THE TELEPHONE.

LOS ANGELES, CALIF.—The Home Telephone Company, which is installing an independent system in Los Angeles, is pushing the work of laying conduits in Seventh Street in advance of the paving of that street. The new central office will be equipped with a multiple switchboard.

SAN FRANCISCO, CALIF.—In the recently-issued directory of the Sunset Telephone & Telegraph Company, the following announcement is made: "All the stations of the Pacific States and Sunset Telephone & Telegraph Companies are being equipped as rapidly as possible with Morse telegraph instruments in order that a regular telegraph business may be done over the lines of the companies. Telegrams should be accepted by all agents and employees whenever offered for transmission. If there are no telegraph instruments at your office, the message will be telephoned to the nearest office equipped with instruments, so that it may be forwarded by telegraph from there to its destination. All employees are particularly cautioned against refusing to accept any such messages." It is stated that this action was taken in order that the Sunset Company may enjoy certain privileges that, as a telephone company, it cannot now exercise. Under the "Post Roads Act" telegraph companies are privileged to erect poles and wires on all post roads. This act, it has been ruled recently, does not apply to telephone companies, because at the time of its enactment telephones were not in existence. As a consequence the telephone companies are now preparing to do a crtain amount of legitimate telegraph business in order to enjoy similar privileges to those of the telegraph companies. It is explained that a war with the telegraph companies it not at all intended.

FLORENCE, COLO.—The Colorado Telephone Company is arranging to supply the farmers here and at Canon City with a telephone service.

STREATOR, ILL.—The Benson Telephone Company has been incorporated with a capital stock of $10,000.

BRIMFIELD, ILL.—The telephone company recently increased its capital from $500 to $5,000 and is now wiring the whole township.

DUQUOIN, ILL.—The Illinois Central Railroad telephone system is completed between this city and Centralia. Three districts of the Illinois Central are now equipped with the telephone, Carbondale to St. Louis, Kankakee to Chicago and Duquoin to Centralia. Work commenced last week extending the system from this city to Carbondale, and only a few days will be necessary to complete the work. The district between Centralia and Kankakee will next be equipped with the telephone.

CARROLLTON, IND.—The Carrollton Telephone Company, capital $900, has been incorporated.

RISING SUN, IND.—The Ohio River Telephone Company, capital stock $45,000, has been incorporated. Directors, S. Beymer, G. I. Moore, Wm. M. Green and others.

ANGOLA, IND.—The Steuben County Electric Telephone Company installed 100 new telephones during March. The company now has out about 800 instruments in use.

INDIANAPOLIS, IND.—Tillman Mitchell has brought a suit against the Central Union Telephone Company to recover $10,000 damages for injuries received by being run down by the city fire chief's buggy in an alley where, he alleges, the company has unlawfully erected a pole which obstructed his view and was thereby the direct cause of his injury.

INDIANAPOLIS, IND.—The following telephone companies were incorporated recently: The Porter & Horning Ridge Telephone Company, of Hancock County, capital $3,000; president, John W. Jackson, Greenfield; the Leamon's Corner Telephone Company, of Hancock County, capital $1,400; directors, Robert and John Scott and O. H. Wyant; the Worthington Telephone Company, capital stock $10,000; directors, W. B. Squire, W. B. Harrah and others, and the Yellow Jacket Citizens' Co-operative Telephone, of Poplar Ridge, with a capital stock of $2,500. The directors are Alexander McHargue, Charles Searing, S. A. Moore, J. M. Thompson and others.

WYOMING, IA.—The Wyoming Telephone Company was granted a franchise at the city election.

BOONE, IA.—The Hawkeye Telephone Company is constructing a line connecting Berkeley with this city.

GUTHRIE CENTER, IA.—The Guthrie Center & Northwestern Telephone Company has increased its capital stock from $2,000 to $5,000.

TULSA, I. T.—The Indian Telephone and Construction Company, capital $25,000, has been incorporated by R. H. Hall, James N. Hall, and Luther D. Marr.

ALTOONA, KAN.—The Altoona Co-operative Telephone Company, capital $21,000, has been incorporated.

TOPEKA, KAN.—The Kansas & Missouri Telephone Company will erect an exchange building on West Sixth Avenue, between Jackson and Van Buren Streets.

BANGOR, ME.—The New England Telephone & Telegraph Company of this city will construct a new exchange soon.

HOLTON, MICH.—The Rural Telephone Company has been established at Holton with a capital stock of $3,500.

JACKSON, MICH.—The Trist Telephone Company has been incorporated with $2,000 capital. Andrew Reithmiller is president. It operates lines from Trist to Munith.

DETROIT, MICH.—It is probable that the People's Telephone Company of this city, which has already expended $400,000 in the construction of the plant and had to quit, will be sold to local interests.

DETROIT, MICH.—Business men are dissatisfied with the increased rates announced by the Michigan Telephone Company on private switchboards and extension telephones. Many of them have been ordered out.

HUDSON, MICH.—The Rollin Telephone Company, which covers nine townships and gives connection with all the towns in this vicinity, is extending its line to Jackson, Hillsdale, Jonesville and Coldwater. It has over 300 telephones in use.

DETROIT, MICH.—The Detroit Co-operative Telephone Company has called for an assessment of 20 per cent on stock subscriptions. Secretary Williams states that if assessments come in liberally work on the construction of the plant will be started at once. If they do not, the project will be given up.

PONTIAC, MICH.—At the annual meeting of the Oakland County Telephone Company the following officers were elected: Peter I. Meloy, president; J. A. Graley, vice-president; A. G. Griggs, secretary; F. G. Jacobs, treasurer; C. S. Bartlett, James H. Lynch, Walter Knox, A. Parker, J. W. Martin and the officers, directors.

ST. PAUL, MINN.—The Twin City Telephone Company will extend its service to the lake region and will commence building at once.

BRAINERD, MINN.—The City Council has granted the Mille Sacs Telephone Company permission to extend its lines into this city.

MINNEAPOLIS, MINN.—The Minnesota Telephone Company, of Minneapolis, has been incorporated with a capital stock of $50,000. The incorporators are A. B. Kerlin, Park Rapids; W. N. Carroll, C. P. Wainmann and D. F. Morgan, Minneapolis.

MINNEAPOLIS, MINN.—The Minnetonka Telephone Company, of Minneapolis, has been incorporated with a capital stock of $50,000. The incorporators are A. B. Kerlin, Park Rapids; W. N. Carroll, C. P. Wainman and D. F. Morgan, Minneapolis.

ST. PAUL, MINN.—The Twin City Telephone Company has been granted a franchise by the Council of Excelsior for a telephone system. It is the intention of the company to build the line direct to Excelsior from Minneapolis and operate an exchange there.

ELLIOT, MO.—The Dix Telephone Company, capital stock $3,000, has been incorporated.

ST. LOUIS, MO.—The contract for erecting a new building for the Kinloch Telephone Company in this city has been awarded to E. A. Slininger, subject to certain modifications that may be made in the selection of materials. The price is about $37,000.

UNION, NEB.—Plans are being made by the Independent Telephone Company for an exchange.

SOUTH OMAHA, NEB.—The Excelsior Electric Signal & Manufacturing Company is installing an independent telephone system in South Omaha under a franchise granted some years ago. Douglas County, in which South Omaha, Omaha and several other good towns are located, makes this the most desirable territory in the West that has not been entered by independent companies. This move insures connections with some twenty counties in the southeastern part of Nebraska, thus enabling stock growers in that section to have communication with the stock yards and packing house industry at South Omaha. This is the first move toward opening Omaha and Council Bluffs, Ia., up to independent systems.

TRENTON, N. J.—The Wyoming Valley Telephone Company has been incorporated with a capital stock of $25,000. The incorporators are E. E. Pryor, Charles F. Wagner and Philip Kingsland. The headquarters of the company are at Camden.

ITHACA, N. Y.—The New York and Pennsylvania Telephone & Telegraph Company will construct a direct line between Hornellsville and Bath.

BUFFALO, N. Y.—The Local Telephone Company of Buffalo has been incorporated, to operate between villages in Western New York. Capital, $10,000.

UTICA, N. Y.—The contract for the construction of the entire system of the Utica Home Telephone Company has been let to the Central Construction Company of Wauseon, Ohio.

DUNKIRK, N. Y.—An exchange will be built here by the new telephone company which filed a certificate of incorporation with a capital stock of $10,000. Edw. Randall and F. S. Porter, of Buffalo, are among the directors.

ROCHESTER, N. Y.—The Consolidated Telephone Company is at work on long-distance lines connecting Rochester, Syracuse and intermediate towns. The company has an exclusive contract with the Rochester Telephone Company for long-distance connections.

NEWBERN, N. C.—The Telephone Company of America has been granted a franchise here.

MARSHALL, N. C.—The Madison Telephone Company is constructing a line from Marshall to Alexander via Weaverville.

CHARLOTTE, N. C.—The building of a new telephone line from Whiteville to Wilmington, N. C., is being agitated. J. D. Maultsby, of the former town, can possibly give information.

STRATFORD, N. C.—It is proposed to organize a telephone company to construct a line from Sparta to Scottville. This will give a direct line from Sparta to Jefferson via Healing Springs.

LEIPSIC, OHIO.—The Mutual Telephone Company has commenced stringing wires into Leipsic and will install an exchange here.

YOUNGSTOWN, OHIO.—The Beaver Telephone Company is purchasing the required equipment, and work on the exchange will start in the near future.

MARION, OHIO.—The Marion County Telephone Company is receiving large supplies of overhead equipment and will commence stringing wires at once.

BRYAN, OHIO.—The Bryan Telephone Company is making arrangements to extend its system throughout the surrounding farming district this spring. The company is rushed with new business.

PAINESVILLE, OHIO.—The Council has granted an ordinance to the Painesville Telephone Company, permitting it to fix its rates at $12 and $20 for residences and $24 and $36 for business offices.

HICKSVILLE, OHIO.—The Hicksville Telephone Company will issue more stock and devote the new capital to building a line from here to Maysville. It expects to secure a large list of farm telephones along the route between these two points.

CINCINNATI, OHIO.—The Fitzsimmons Telephone Manufacturing Company, which claims to hold a franchise for an independent system in Cincinnati, recently applied to the Board of Public Service for permission to use a line 100 feet long, owned by another company; the owners' consent having been obtained. The corporation counsel advised the board to refuse the permit, as he claims the company has no valid franchise.

DAYTON, OHIO.—Local parties interested in the Dayton Home Telephone Company have taken up the option on the Everett-Moore interests in the property and the system will be completed by them. It is understood that about $90,000 was paid for the Everett-Moore interests. The property will probably be conducted in connection with that of the Columbus Citizens' Telephone Company, which has been virtually secured by the same interests.

ASHLAND, OHIO.—The Central Union Telephone Company is suing in the Probate Court to force the Council to grant a franchise for a local exchange. The Village Council claims the company was granted a franchise in 1883, which it abandoned and refused to operate, hence is not entitled to another franchise. It is also claimed that the independent service now given is satisfactory and that another exchange would be a hardship. The court has the matter under consideration.

CINCINNATI, OHIO.—It is stated that independent telephone companies are knocking hard for admission to Cincinnati. Those companies with applications now in are: Kentucky Telephone Association, Cynthiana, Ky.; Old Kentucky Telephone & Telegraph Association, Winchester, Ky.; Mt. Vernon Telephone Company, Mt. Vernon, and the Fitzsimmons Telephone Company, which has been refused a permit on the streets of Cincinnati. Some believe this latter concern has a valid franchise.

CLEVELAND, OHIO.—The bankers committee in charge of the affairs of the Federal Telephone Company has given options on eight of the twenty-three constituent companies of the Federal Telephone Company as follows: Canton, Portsmouth, Findlay, Lima, Bowling Green, Columbus, Dayton and Detroit. In each case the prospective purchasers are the local parties who hold the minority interest in the respective companies, and the options were given with the understanding that there shall be no sale or consolidation which shall place the exchanges in the hands of the opposition. It is generally understood that if several of these sales are effected the remaining Federal properties will be reorganized.

OTTAWA, ONT.—The Ottawa City Council has decided to advertise for tenders for a telephone service with a capacity of 4,000 subscribers, rates not to exceed $20 per annum. The cost of the Bell telephone plant, which at present serves only 2,500 subscribers in Ottawa, was $185,000. The annual revenue is about $70,000, of which $30,000 is set aside for maintenance, etc. This leaves $40,000 net earnings, and represents a profit of over 21 per cent.

OTTAWA, ONT.—The Bell Telephone Company of Canada has again got its bill, authorizing the doubling of its present capitalization, before the Dominion Parliament. The obnoxious clauses of the bill, which brought about its defeat in the Canadian Senate last year, have been eliminated from the new bill. One object for which the present increase of capital is asked is to enable the company to extend the long-distance telephone to the Northwest.

MARCHAND, PA.—The Farmers' Telephone Company is building a line from Rochester Mills to this place.

YORK CITY, PA.—The Chartiers Telephone Company, of McDonald, has been incorporated with a capital of $1,000.

CHESTER, PA.—The new system of the Delaware and Atlantic Telephone Company in this city is now in operation.

ANNVILLE, PA.—The United Telephone and Telegraph Company has extended its service to Myerstown. Other lines are being built.

POTTSVILLE, PA.—The charter for the Carbon Telephone Company has been filed. The company will operate a telephone system in Carbon and Schuylkill counties.

YANKTON, S. D.—The Western Electric Telephone system proposes to build a line from Tabor to this city.

STAR CITY, TENN.—The Star City Telephone Company has been chartered with a capital stock of $10,000.

MEMPHIS, TENN.—The Memphis Telephone Company of Memphis, which recently constructed a system here at a cost of about $500,000, now has its system in operation.

GLEASON, TENN.—The Cumberland Telephone Company has taken charge of the local telephone system and is making many improvements. The system has heretofore been operated by the Weakley County Company.

AUSTIN, TEX.—The Roberts Telephone and Electric Company, of Abilene, capital stock, $50,000, has been incorporated.

COLLINSVILLE, TEX.—A local telephone system is being put in here, with between twenty-five and thirty subscribers, also a line from this place to Ethell, five miles east of here.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company and the Montana & Wyoming Telephone Company are still fighting in the northern part of Wyoming. The latter company has secured franchises in Cody, Red Lodge and Meeteetsé, but was turned down in Thermopolis.

FOND DU LAC, WIS.—The Little Wolf River Telephone Company has passed into the hands of a receiver.

MADISON, WIS.—The Iowa County Telephone Company of Cobb has been incorporated with a capital stock of $6,000; incorporators A. E. Thomas, A. Livingston and C. R. Fox.

ELECTRIC LIGHT AND POWER.

LODI, CALIF.—There are three projected plans of electric current for lighting this place. Cary Brothers intend to install an electric plant which will supply lights next fall.

SAN FRANCISCO, CALIF.—The Northwestern Improvement Company has been granted a franchise for the construction of light, heat and water conduits and telephone lines in the town of Cle Elum, Wash.

SAN FRANCISCO, CALIF.—The Northern California Power Company recently petitioned the Board of Supervisors of Glenn County for a franchise for the extension of its electric transmission line to Willows.

SAN FRANCISCO, CALIF.—The Central California Electric Company, which is allied to the South Yuba Water Company, recently asked for a franchise for its electric transmission line in Nevada County. Grass Valley and Nevada City are the objective points.

SAN FRANCISCO, CALIF.—The San Antonio Water Company recently petitioned the trustees of Oxnard, Calif., for an electric light and power franchise. Current will be supplied from the company's electric transmission plant which is in course of construction.

RIVERSIDE, CALIF.—The Riverside Power Company, which has contracted to supply electric lights for the city of Riverside, has declared its intention to issue bonds to the amount of $250,000. The lighting contract with C. G. Baldwin has been cancelled by the city trustees, as he was unable to place the bonds for his electric lighting project.

LOS ANGELES, CALIF.—The Arizona Power Company, of which F. J. Thomas, of Los Angeles, is president, has secured capital to carry out its plans. Electric power will be generated on Fossil Creek, near Verde, and 55 miles from Prescott. It is estimated that about 4,000 hp can be generated and transmitted to the mining districts surrounding Prescott.

SAN FRANCISCO, CALIF.—The Mount Whitney Power Company, Wm. Hammond, president, will construct a power line from its Porterville electric station to the wells of the Sunnyside Water Company. The line to Plano will be extended in a southerly direction. An additional 1,000 hp development will be made at the generating station on the Kaweah River in California.

SAN FRANCISCO, CALIF.—The Standard Electric Company recently tested the electrical apparatus in its new San Francisco sub-station and everything was found to be satisfactory. Current from the Bay Counties Power Company's Colgate powerhouse was used in testing, the distance of transmission being 223 miles—the longest on record. The Standard Company's powerhouse at Electra will be in operation by May 1.

SAN FRANCISCO, CALIF.—The Utica Mining Company will increase the capacity of its electric power plant which supplies Angels, Calif. An additional pipe line will be laid. The power station is located about 6 miles from Murphys and has room for three 1,000-hp units, each consisting of a generator and water-wheel. A second Westinghouse two-phase generator of 1,000-hp capacity will be installed. The Utica mine and other points will receive current.

VAN HORN, IA.—Mr. J. A. Uicke, of Van Horn, expects to have a franchise granted early in May, and if he gets it will put in a plant at once.

BALTIMORE, MD.—The Lynchburg Water Power Company, recently organized at Lynchburg, Va., has purchased the dam and other property at Reusens, four miles above the city, and will improve it for an electric plant, which will furnish 4,000 horse-power for manufacturing purposes.

MONROE CITY, MO.—The City Council is consulting with several electricians and getting an estimate of the cost of an electric light plant for the city. As soon as estimates are secured a special election will be ordered for the purpose of voting on the proposition to issue bonds to pay for a plant.

ST. LOUIS, MO.—The St. Louis Transfer Company is to supply the power for operating the staff plant and sawmills of Goldie & Company, who have the contract for constructing Electricity Building for the World's Fair. A contract was signed a few days ago by Goldie & Company with the Sprague Electric Company of New York for a 30-hp 500 volt motor.

WELLSTON, MO.—The *Iron Age* reports that J. M. Nelson, Jr., president of the recently organized Wellston Gas, Water & Power Company, Equitable Building, St. Louis, Mo., is in the market for entire equipment for their proposed new plant, and that they would be pleased to hear from parties familiar with the erection and installation of gas, water and electric plants. The company have secured a franchise and will erect a plant at Wellston, a suburb of St. Louis, capable of furnishing gas, water and electricity to a population of about 15,000.

VIRGINIA CITY, NEV.—The Utah mine near this city is about to install an electric hoist.

BLOOMSBURG, N. J.—The Convertible Car Co. is to put up new works at Bloomsburg, with the machinery all driven by electricity. The power plant will include three 260-hp direct connected generating units.

NEW BREMEN, OHIO.—The village will vote on the proposition to issue $15,000 bonds for the purpose of building a municipal lighting plant. The proposition will probably carry.

CRIDERSVILLE, OHIO.—W. P. Freeman, formerly of Hamilton, will open a factory in this place for the manufacture of electric novelties and will install a lighting plant sufficient to illuminate the village.

SPRINGFIELD, OHIO.—The Citizens' Heating and Power Company, with a capital of $10,000, has been incorporated by Walter L. Weaver, John L. Zimmerman, Frank P. Torrence, William W. Keifer and Frank H. Clarke of this city.

FOSTORIA, OHIO.—Officials of the Baltimore & Ohio, Ohio Central, Nickel Plate and Hocking Valley railroads have decided to install an electrically-operated block system at their crossings in this city. An electric light plant is to be installed, which will illuminate the stations and yards of the companies as well as furnish power for the interlocking system.

HAMILTON, OHIO.—The first trip of canal boats on the Miami and Erie canal, drawn by an electric motor, was made recently. Six boats in line, laden with material for building the line to Cincinnati, were drawn easily to Port Union, a distance of five miles. Material will be transported in this way daily as the track laying is extended toward Cincinnati. The line is expected to be open for traffic from here to Cincinnati early in June.

LAWTON, OKLA.—Mr. Ed. Wagemann is installing a plant at Lawton, including a 90-kw single-phase Westinghouse generator, a 120-hp Russell engine, a 100-hp boiler and 40 enclosed alternating arc lamps for the streets.

OTTAWA, ONT.—Several Toronto gentlemen are petitioning the Dominion Government to incorporate the Dominion Power Company. The purpose of the company is to generate and transmit power for lighting, heating, power, etc. The capital of the company will be $5,000,000. The company also proposes to run an electric railway between Niagara Falls and Toronto.

PITTSBURG, PA.—The Monongahela Light Company has been incorporated here with a capital of $1,000.

PAWTUCKET, R. I.—Work has commenced on the addition to the plant of the Pawtucket Electric Company. The contract for new machinery has already been placed, and will be delivered as soon as the new building is ready to receive it.

MEMPHIS, TENN.—The conditional sale of a majority of the stock of the Memphis Light & Power Company, capitalized at $500,000, was made on April 14, the purchasers being Anthony Brady, of New York, and C. K. G. Billings, of Chicago.

NEWPORT NEWS, VA.—McClare, Hamilton & Rumner, of New York, have sold a complete electrical equipment to the Warwick Brewing Company, of Newport News, Va., to develop 150 kw.

RICHMOND, VA.—The Electrical Construction Company of Virginia, of Emporia, Va., has been awarded the contract for the erection of a large electric plant in the town of Emporia, in Greensville County.

THE ELECTRIC RAILWAY.

WILMINGTON, DEL.—The Delaware Electric Traction Company has been incorporated at Dover, Del., with a capital stock of $1,000,000.

TAMPA, FLA.—Application has been made for a charter for the Tampa Municipal West Coast Development Company, capital $1,000,000. The purpose of the company is to build a street railway and electric lighting plant in Tampa.

BRUNSWICK, GA.—An electric street car system will probably be established here.

WABASH, IND.—The Wabash Traction Company has completed the purchase of the city lines of Logansport, Ind. The company is operating 18 miles of line between Wabash and Peru, and will at once extend its interurban line to Logansport, a distance of 14 miles.

LEXINGTON, KY.—The first step toward the building of the proposed electric railways throughout the Blue Grass region was taken recently by the Consolidated Traction Company, a concern capitalized at $7,000,000.

SAGINAW, MICH.—At a meeting, on April 8, of the directors of the Saginaw Valley Traction Company, it was decided to make extensive improvements to the system. Several cars will be purchased, the old cars will be rebuilt, and a new 500-hp unit will be installed in the power station.

MINNEAPOLIS, MINN.—The Mankato & St. Peter Railway & Lighting Company has been incorporated, capital stock of $300,000, for the purpose of building and operating a street railway in Mankato with an extension to St. Peter, Kasota and other points. It will also maintain a public electric lighting and heating plant and a gas plant. W. L. Hixon is president; W. D. Willard, vice-president; N. F. Clark, secretary, and W. G. Hoen, treasurer.

ALBANY, N. Y.—The Auburn Interurban Electric Railway Company, Auburn, N. Y., has increased its capital from $250,000 to $1,000,000.

NEW YORK, N. Y.—The Metropolitan Street Railway Company is changing the old Ninth avenue horse-car line over to the electric conduit system.

ALBANY, N. Y.—The Tuscarora Valley Railroad Company, of Painted Post, has been incorporated with a capital of $200,000 to construct an electric surface railroad, nineteen miles long, between Addison and Jasper, Steuben County.

CANTON, OHIO.—Work has been started on the power house of the Canton-Akron and Canton-Massillon lines at Canton. The equipment for the station was ordered some months ago, when it was intended to build a station between Canton and Akron. It is about ready for delivery, so that work on the building will be pushed.

EAST LIVERPOOL, OHIO.—The United Power Company, which operates the local street railway lines, has placed contracts for an addition to its power house.

DAYTON, OHIO.—The Dayton, Lebanon & Cincinnati Railway Company is securing right of way from Lebanon Junction into Dayton, a distance of five miles. The road is owned by the Appleyard syndicate, and is to be connected with the Dayton, Springfield & Urbana Railway, to form part of the through line from Columbus to Cincinnati.

CELINA, OHIO.—The Western Ohio Railway Company has its trolley wires stretched within about one-half of a mile of this city, and it also has most of its rails laid. The company expects to have cars running into Celina within 30 days. This will be the terminal point of the road for the present, but later on, it is currently reported, it will extend its line to Indianapolis, Ind.

CLEVELAND, OHIO.—The Cleveland City Railway Company is now pushing work on an addition to its power station. The company has recently contracted for 20 double and 10 quadruple Westinghouse No. 49 equipments to be placed on 15 Kuhlman and 15 Brill 14-bench open cars. Contracts have beeen closed for 18 Brill and 17 Kuhlman 30 ft. double truck closed cars for fall delivery.

HAMILTON, OHIO.—The board of control recently granted a franchise to the Millcreek Valley Traction Company, enabling it to reach the center of the city, passing the measure over the previous veto of the mayor. Immediately afterward, certain property owners brought suit to enjoin the company from building, on the grounds that the action of the board of control was illegal. The company has been working for several years to secure this grant.

CLEVELAND, OHIO.—Needham, Reynolds & Company, promoters and brokers of this city, claim to have completed a deal for the consolidation of the Youngstown Park & Falls Railways Company of Youngstown; the United Power Company of East Liverpool; the East Liverpool & Wellsville Street Railway of East Liverpool; the Chester Street Railway Company, of Chester, W. Va.; and the Wellsville & Steubenville Traction Co. of Wellsville. The consolidated company will be known as the Ohio River & Youngstown Railway Company. Bonds to the amount of $4,000,000 are to be issued. It is the chief aim of the project to build an interurban line from Youngstown to East Liverpool, a distance of 55 miles; also a line from Wellsville to Steubenvillle.

CLEVELAND, OHIO.—At the instigation of Attorney Minor G. Norton, Senator Harris has introduced a bill in the state legislature authorizing the construction of elevated or subway railways throughout Ohio under certain conditions. Such roads can be elevated, or in subways, or both. Over private rights of way they are given the right of eminent domain. If they run over streets they must obtain consents of property owners. They are empowered to make traffic arrangements with other similar companies providing they are not competing lines, but they may not consolidate with or make traffic arrangements with surface lines. Permission to build such lines must be secured from municipalities or county commissioners. Mr. Norton admits the bill is especially designed for Cleveland, with a view to providing speedy traffic through the city as well as entrance for suburban lines.

MANITOWOC, WIS.—Not only will the new electric railway between Manitowoc and Two Rivers be open by May 1, but the proposed extension from Two Rivers to Mischiott will be built during the coming summer. Next summer the line will also be extended from Mischinott to Kewanee.

OTTAWA, ONT.—The Shawinigan Falls Electric Railway Company is preparing to extend its electric lines through the town of Shawinigan Falls, Que.

OTTAWA, ONT.—Estimates have been asked for an electric railway, about eleven miles long, to connect Maple Lake station with Port Cockburn and Rousseau, Ont. Two waterfalls along the line of the proposed railway will furnish all the power needed. The road will be extended to Parry Sound eventually, thus giving a railway twenty-six miles long.

PHILADELPHIA, PA.—Notice has been published of the proposed incorporation of the Philadelphia Rapid Transit Company, which will undertake the construction and operation of the subway under Market street and the management of the Union Traction Company.

NEW INDUSTRIAL COMPANIES.

THE MUNICIPAL ELECTRO CHEMICAL COMPANY of Jersey City, N. J., has been incorporated; capital, $100,000. Incorporators: Osborn Congelton, Henry F. West and Geo. H. Cook, all of New York City.

THE CEDARBURG & MILWAUKEE MOBILE COMPANY has been organized at Cedarburg, Wis., with a capital stock of $10,000. The company will run an automobile stage line from North Milwaukee to Cedarburg.

THE COLONIAL SIGN COMPANY of Akron, Ohio, has been incorporated with $25,000 capital stock. The company will manufacture electric signs on a number of features for which it has obtained patents. It is preparing to locate a factory in Akron.

THE NORTHERN ELECTRICAL CONSTRUCTION COMPANY has been organized at La Crosse, Wis., with a capital of $100,000 for the purpose of financing companies and constructing electric light plants, power plants, telephone exchanges and street and interurban electric railways. M. J. Berger is secretary and G. L. Saunders engineer.

THE ST. LOUIS GLASS MANUFACTURING COMPANY has filed articles of incorporation. Its capitalization is $50,000, and its purpose is to manufacture gas, electric and combination fixtures, lighting appliances and mantels. The company is a consolidation of the General Lighting Appliance Company and the Phœnix Gas & Electric Fixture Manufacturing Company. Its temporary location will be at 1607 Oliver Street. The officers are G. A. Pleus, president; Alfred C. Einstein, vice-president; Charles M. Wentner, secretary, and Edwin F. Guth, treasurer.

LEGAL.

VAN CHOATE ELECTRIC COMPANY.—The property in Foxboro, Mass., of the Van Choate Electric Company was sold at public auction on April 14 to the Attleboro Savings Bank for $58,000.

POSTAL IN COLORADO.—The Supreme Court of Colorado has decided that the Postal Telegraph Company may construct lines along the right of way of the Union Pacific Railway.

OBITUARY.

MR. JACOB WEINHEIMER, president of the St. Louis Electrical Supply Company, St. Louis, Mo., died in that city on April 7. He was born in St. Louis in 1837.

PERSONAL.

PAUL W. BOSSART.

MR. PAUL W. BOSSART was one of a number of expert telegraphers selected by the managers of the American Bell Telephone Company early in telephone history to do the pioneer work incidental to introducing the telephone in a practical way for commercial and social purposes. His first assignment was to install an exchange in Kansas City, Mo., in 1879, which was followed by exchanges in St. Joseph, Mo., Atchison and Leavenworth, Kan., then the larger towns in Kansas. All of these were successfully constructed and operated under his supervision and management until 1884, when he was transferred to Eastern territory with similar duties on a larger scale. In 1885 a flattering offer from Mr. Edison to enter his service induced him to leave the telephone field, which he re-entered shortly after the expiration of the fundamental Bell patents, again taking up pioneer work in connection with the independent telephone movement. His previous training and experience in the telephone business and other branches of electrical work closely allied therewith, peculiarly fitted him to enter this field with advantage to his employers. His first connection with the later telephone manufacturing interests was with the American Electric Telephone Company, with which concern he remained about four years, holding the title of assistant general manager, and materially assisting in building up the business of that company. He subsequently accepted a position with the Kellogg Switchboard & Supply Company, with which company he is at present engaged as manager of the Eastern District, with headquarters in Philadelphia, Pa.

MR. B. E. SUNNY, Western manager of the General Electric Company, has recently been elected president of the Civic Federation of Chicago.

COL. ALLAN C. BAKEWELL, general manager of the Sprague Electric Company, has recently been elected second vice-president of the Pennsylvania Society of New York.

MR. CHARLES A. TINKER, general superintendent of Western Union, Eastern Division, has resigned, and Mr. B. Brooks, superintendent at Denver, has been appointed to succeed him.

MR. DUFFIELD PRINCE, formerly with the Brooklyn Edison Illuminating Company, and an old associate of Mr. W. S. Barstow, has joined the office force of that consulting engineer, at the Bowling Green Building, New York City.

MR. LEWIS McKISICK, the Western Union Telegraph Company's assistant manager of the Pacific Coast lines, has been called to Chicago, where he will hold a very responsible position. He has been stationed in San Francisco for the past twelve years.

MR. J. B. HAMILTON, general manager of the Leeds Corporation Tramway, has been visiting this country to inspect American traction systems, and has now sailed for England, after an extensive tour of investigation. He was formerly assistant manager of the Glasgow system.

LORD AND LADY KELVIN left New York on Tuesday morning for Washington in the private car of Mr. George Westinghouse, by whom they will be entertained in that city. They are then to visit Rochester, Cornell University and Yale University before returning to New York, to sail for home on May 10.

MR. R. H. KLAUDER, St. Louis representative of the Electric Storage Battery Company, addressed the Engineers' Club, St. Louis, Mo., April 16, on "Present American Storage Battery Practice." Mr. Klauder dealt with the use of storage batteries in power plants. The address was illustrated by stereopticon views.

MR. J. Z. RISCH, Cz., of Delft, Holland, a recent graduate of the electrical engineering course of the American School of Correspondence, Boston, Mass., has been appointed instructor in electrical drawing and design in a technical school at Leyden. Mr. Risch is also a graduate of the American School's marine engineering course.

MR. L. GRIMESY, manager of the Yokohama offices of the American electrical engineering and contracting firm of Bagnall & Hilles, which concern has recently secured some important contracts for American equipment for various Japanese traction and lighting plants, is now in the United States. He expects to remain in this country for some two months. He may be found at the New York offices of the General Electric Company.

HON. L. J. FORGET has resigned from the directorate of the Shawinigan Falls Water & Power Company of Montreal. He opposed the bringing of power to Montreal by that company, but was overridden by the other directors. Senator Forget is a director of the Montreal Light, Heat & Power Company, and, as the Shawinigan power will conflict with the latter company's business, he decided that as the two interests clashed, he would resign the Shawinigan directorate.

MR. E. W. STEVENSON, who is the electrical engineer of the Hazard Mfg. Co., at Wilkesbarre, Pa., has been lecturing there with great success on telegraphy. Mr. Stevenson has been intimately associated with this branch of the business from his infancy, his father having been one of the pioneers connected with the Great Eastern expeditions and the Telegraphic Maintenance & Construction Company, which has laid 75 per cent of the cables now in existence. Mr. Stevenson's reminiscences were also very entertaining, being full of anecdotes of his personal experiences in different parts of the world. The description was well illustrated by drawings which served to make the lecture very clear and lucid. Mr. Stevenson reserves the wireless telegraph as the climax to his talk.

Trade Notes.

THE STANLEY INSTRUMENT COMPANY will move to 156 Broadway, New York, on or about April 26.

THE AKRON ELECTRICAL MANUFACTURING COMPANY, Akron, Ohio, will enlarge its facilities by adding another story to its factory.

CHAS. E. FELT & COMPANY have opened an office as mechanical and electrical engineers at 1155 Monadnock Block, Chicago. D. Avery Kimbark is consulting electrician.

MR. T. J. CALLINAN, Williamson Building, Cleveland, Ohio, has taken the exclusive American and foreign agency for the Barrett rail bond, which, for some time, has been manufactured by the Cleveland Bronze & Brass Works.

MERWARTH METALLIC GASKETS.—To meet the demand of increasing business, the Merwarth Metallic Gasket Company has moved from 107 Liberty Street, into larger quarters in the Beard Building at 120 Liberty Street, Rooms 604 and 605.

THE CUTLER HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has purchased a block of property which is to be used for enlarging its plant. The company is in great need of more factory space. It is exceedingly busy, as usual.

THE M. M. MAYER ELECTRIC COMPANY, which has had a great deal of success in exploiting its motors for varied power work, has recently moved to 216 Centre Street. This brings it more nearly into the heart of the business section of New York City.

PACIFIC COAST AGENCY.—John Martin & Company, of San Francisco, have taken the Pacific Coast agency for the electric motor department of the Lorain Steel Company. An order for street railway equipments has been received from the Pacific Electric Railway Company of Los Angeles.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, it is reported, is having a large call for its new long-lever gravity telephone switchhook. It is said the "International" switch may be readily placed in practically any make of telephone, it being less than one inch in width and all parts self-contained.

GARTON LIGHTNING ARRESTERS have been on the market for several years and are regarded as standard goods. The Garton-Daniels Company, Keokuk, Ia., has just issued a very complete and well-illustrated catalogue of its latest improved lighting arresters for electric light, power and railway circuits of any voltage, direct or alternating current.

REMOVAL.—The Le Valley-Vitæ Carbon Brush Company will, on May 1, remove its offices from 45 Broadway to 119 East Forty-second Street, New York. At the new location the company will have, in addition to its offices, a storeroom, where it will carry a large quantity of its brushes, so that it will be in a position after that date to make prompt delivery of almost any size of brush used.

THE STANDARD POLE & TIE COMPANY, 44 Broad Street, New York City, advises us that on May 1 it will move into larger quarters. It has been very badly crowded for some time, and the volume of business which it is handling makes it absolutely necessary to secure more space. It will still have offices in the General Electric Building, and invites its friends to call at its new rooms.

THE FORT WAYNE ELECTRIC WORKS have recently issued Bulletins 1020 and 1021, the former dealing with belted direct-current multipolar generators. This type of machine is illustrated complete and in parts, and a general description of the machine is given, together with tables of dimensions. Bulletin 1022 describes and illustrates in a similar manner belted direct-current multipolar motors.

DIRECT-READING OHMMETER.—The Illinois direct-reading ohmmeter, manufactured by the Illinois Electric Specialty Company, Chicago, Ill., is evidently giving satisfaction to those who are using it, judging from some testimonial letters published in a circular sent out by the company. This instrument is recommended for quickly locating troubles, either in lines, instruments or cables.

THE CENTRAL ELECTRIC COMPANY of Chicago has published a 1902 addition to its fan motor catalogue, in which is listed a full line of desk, bracket and ceiling fans for all currents and voltages. This catalogue also includes power motors, sewing machine motors, battery fans, ventilating fans, etc. Anyone desiring a copy can procure it by addressing a request to the Central Electric Company.

MECHANICAL DRAFT.—Anyone not familiar with the subject of mechanical draft can find out what it is and what it does by addressing the B. F. Sturtevant Company, Boston, Mass, and asking for a copy of a little pamphlet just issued on that subject. Besides giving this fundamental information, there are illustrations and general descriptions of plants in various places equipped with mechanical draft on the Sturtevant system.

THE ST. LOUIS BRANCH of the H. W. Johns-Manville Company reports having secured the contract for pipe covering in the new Bank of Commerce Building, southeast corner Broadway and Olive Street, St. Louis, Mo. The material used on all main pipes and risers is Asbesto Sponge moulded covering, and the breechings and hot water tank will be covered with magnesia. The total cost of the above contract will be close on to $1,000.

PLAIN MILLING MACHINES.—The Garvin Machine Company, New York, in a catalogue just off the press, shows illustrations of a full line of plain milling machines, the principal features of the machines being pointed out. A comprehensive telegraph code is also given. The Garvin Company has issued a series of catalogues, to be revised as occasion requires, in order to keep its customers in touch with its latest improvements and additions.

EMERSON FANS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is sending out a new booklet entitled "Emerson Fans, and Why We Recommend Them." This booklet is intended to stimulate the demand for

these goods throughout the country. The title exactly describes its contents, and the argument contained therein is an earnest one in favor of Emerson machines. Besides this there are various illustrations showing the different styles of fans manufactured by this company.

CHARLES H. BESLY & CO., Chicago, Ill., report numerous sales of their Gardner grinders. Within the past week shipments of these well-known machines having been made to Oregon, Wisconsin, Connecticut, New York, and Massachusetts. They are receiving many orders from agricultural implement builders for their "Badger" and "Bonanza" oil cups, and are making many shipments of "Helmet" oil through all parts of the country. Their 300 page illustrated catalogue will be mailed free to any address upon application.

AUTOMATIC SWITCH COMPANY.—On the night of April 14 the offices and factory of the Automatic Switch Company, of 131 Liberty Street, New York City, were extensively damaged by fire, the stock and machinery being injured to such an extent as to necessitate practically a new equipment of the main floor of the machine shop. Immediate steps have been taken by the company to put the plant in running order, and it is expected that not more than one week will be required to effect it, after which orders will be filled with the usual punctuality.

STORAGE BATTERY FOR VOLTAGE REGULATION.—The advantages of using storage batteries for voltage regulation on electric railway lines are pointed out in Bulletin No. 70 of the Electric Storage Battery Company, Philadelphia. Curves show the results obtained by the use of a battery on the line of the Chestnut Hill branch of the Union Traction Company, Philadelphia. A statement exhibiting comparative results with and without the battery shows a saving of $22,500 in first cost, and a reduction of $1,100 in annual charges in favor of the battery installation.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is sending out a handsome souvenir mailing card illustrative of the ability of the American engineer to design steel structures of great strength and pleasing architectural effect. The card contains eight illustrations of bridges, buildings and ornamental iron work, on which Dixon silica-graphite paint is used for the prevention of corrosion of the metal. It is stated that this paint has been very extensively used in the South, West and seacoast sections of the United States, also in Mexico, Australia, China, West Indies and Philippine Islands, and has proven its protective and wearing qualities in all climates.

WATCHMAN CLOCKS.—The Waggoner watchman clock, manufactured by the Waggoner Watchman Clock Company, Grand Rapids, Mich., is completely described and illustrated in a pamphlet issued by that company. Among the claims made for this device is the unique manner of registration. The record is printed on the back of a dial by means of a vibrator actuated by an electric current, ordinary push-buttons being used to make the contact. The registration is stated to be entirely secret. This secrecy of registration is stated to be a positive protection against the manipulation of the clock. The features of this system, as set forth in the catalogue, include an automatic watchman's alarm, an automatic fire alarm, and its simplicity and reliability are especiallly pointed out.

CORRESPONDENCE INSTRUCTION BY TELEGRAPH.—A telegram received by the American School of Correspondence, Boston, Mass., from the superintendent of an electric plant in one of the sections affected by the recent floods requested information regarding the treatment of dynamos that had been submerged. An answer was sent immediately by wire, followed by fuller details by mail, so that by the time the water had subsided enough to permit him to work the superintendent knew what should be done. The American School has a "Special Inquiry Department" for answering practical engineering questions, and the frequent requests for information such as this show how the privilege is appreciated by the students.

THE BUFFALO FORGE COMPANY of Buffalo, N. Y., inventor and manufacturer of the Buffalo forges, has just issued its new catalogue for distribution among the trade. It is a handy little book, envelope size, illustrated with half-tone engravings throughout, describing in detail the many different types and sizes of its portable, blacksmiths, machinists, boiler makers, tool makers, riveting, jeweler's forge, bench forge for light work, railroaders and prospectors, bellows, foot-power, brazing and melting forges, and folding forges for marine service. It also includes descriptions of its Buffalo hand blowers, power and hand drills, punches, shears, bar cutters, tire benders and tire upsetters. This catalogue is a handsome effort and well worth securing.

"THE MIDNIGHT SUN" is the title of a pamphlet issued by the Sterling Electrical Manufacturing Company, Warren, Ohio, manufacturers of incandescent lamps. The various types of lamps manufactured by this company are illustrated and their principal features noted. The "Sterling Special" lamp gives full-rated candle-power at all light-giving points of the bulb. The filament is mounted in double spiral form, from which the radiation of light is said to be equal in all directions. In the "Sterling" regular lamp the old type of oval loop-anchored filament is used. The "Phœnix" lamp is the repaired part of the company's product. This lamp is said to equal the new. The company's New York office, at 26 Cortlandt Street, is in charge of Mr. Francis Granger.

TRAVELING ELECTRIC HOISTS.—Pawling & Harnischfeger Company, Milwaukee, Wis., in Bulletin No. 7, describes and illustrates its line of traveling electric hoists. It may be pointed out that the hoists not only hoist but travel also, thus giving full hoisting capacity at the place where needed. Another feature is the ease with which these hoists are installed, only requiring sufficient head room and strength of roof trussing. The runway can be made straight or curved, machines being made for either form. The advantage of the curved runway is that it permits of covering a large part of an extensive plant. The machines are suitable for both inside and outside service; in the latter the mechanism being fully protected by an iron cover and the operator's cage housed in sash. The use of an I beam bridge with these hoists is of value, and the bridge can be readily adapted to the transfer type for application in any plant. The catalogue includes a partial list of users. It is pointed out that the machines are in no sense an experiment.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 15, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

697,158. ELECTRIC CIRCUIT REGULATING DEVICE; G. P. McDonnell, St. Louis, Mo. App. filed Oct. 28, 1901. The principle of operation of this device is a rotating element provided with a series of terminals which are designed to pass a brush, whereby the derived circuit is made and broken periodically and with rapidity, the position of the contact-brush with respect to the axes of rotation of the moving terminals being such that the length of interval of the break may be regulated so that the value of the derived current may be increased or diminished at will. (Issued April 8.)

697,432. BRUSH HOLDER; N. C. Bassett and J. W. Hill, Lynn, Mass. App. filed Aug. 31, 1900. Details.

697,439. ELECTRIC ARC LAMP; H. Bremer, Neheim, Germany. App. filed Sept. 26, 1900. (See Current News and Notes.)

697,445. ELECTRIC CONTROLLER; F. E. Case, Schenectady, N. Y. App. filed June 22, 1898. There is a mechanical connection between the regulating and the brake switches, such that the movement of the regulating switch handle brings the brake switch to one of two operative positions and the further movement of the handle actuates only the regulating switch.

697,458. ELECTRIC LAMP AND LAMP HOLDER; H. J. Dowsing, London, England. App. filed Oct. 28, 1901. The socket contains two pins and the lamp neck two corresponding holes for establishing connection when the lamp is within the socket.

697,469. METHOD OF MANUFACTURING INCANDESCENT ELECTRIC LAMPS; E. S. Gardner, Boston, Mass. App. filed July 22, 1901. The method consists in the manner of mounting a reflector inside of the lamp and surrounding the stem.

697,482. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed Oct. 23, 1900. Details of construction of a lamp adapted for headlight purposes.

697,507. ELECTRIC CONDENSER; G. F. Mansbridge, Wimbledon, England. App. filed Nov. 16, 1900. Consists of two strips of paper wound up together in the form of a roll, each strip being coated on one side with finely divided metal.

697,515. COMBINED JACK AND DROP; K. B. Miller, Chicago, Ill. App. filed Nov. 8, 1901. (See page 731.)

697,528. TELEPHONE; Aristide Neri, Hoboken, N. J. App. filed June 12, 1901. (See page 731.)

697,529.—METHOD OF RENDERING SHARP AND EVEN CUTTING EDGES OF IMPLEMENTS; O. Newhouse, San Francisco, Calif. App. filed March 23, 1901. (See Current News and Notes.)

697,530. THERMO-ELECTRIC SWITCH; J. G. Nolen, Chicago, Ill. App. filed Sept. 12, 1901. Details.

697,533. CIRCUIT BREAKER; W. E. Pimlott, Chicago, Ill. App. filed Sept. 22, 1900. Relates to the means for adjusting the apparatus so as to break the circuit only when the current attains the desired strength.

697,534. MEANS FOR ELECTRICALLY CONNECTING RAILWAY RAILS; W. E. Pimlott, Chicago, Ill. App. filed April, 1901. The fish plates are grooved on their inner surfaces to receive a conducting strip which they hold in contact with the rail end.

697,572. TROLLEY HARP; T. N. Turner and G. R. Mitchell, Springfield, Ohio. App. filed Sept. 11, 1901. The wheel is in a frame pivoted to the end of the pole, permitting it to swing laterally, anti-friction balls being inserted between the two frames.

697,589. ELECTRIC FAN; J. J. Wood, Fort Wayne, Ind. App. filed Feb. 25, 1901. The armature and field magnet are surrounded by two shells separated on a plane transverse to the armature shaft and having means for supporting the field magnet.

697,619. TELEGRAPH SOUNDER; G. A. Green, Duxbury, Mass. App. filed April 15, 1901. The armature of the sounder moves a hammer to strike a drum.

697,628. INSULATOR AND ATTACHMENT FOR ELECTRIC WIRES; C. C. Johnston, Scranton, Pa. App. filed Sept. 11, 1901. The cap of the insulator, in screwing on to the body portion, clamps the wire between the two parts.

697,654. TRAIN SIGNAL; A. Novak, Trenton, N. J. App. filed Nov. 30, 1901. Circuits are completed by two trains approaching each other on the same track to operate signals in the cabs of both engines.

697,660. WINDING MACHINE; M. I. Pupin, New York, N. Y., and S. W. Balch, Montclair, N. J. App. filed Aug. 31, 1901. (See Current News and Notes.)

697,670. ALTERNATING CURRENT MOTOR; F. Schrottke, Berlin, Germany. App. filed Jan. 6, 1900. (See Current News and Notes.)

697,671. ALTERNATING CURRENT METER; F. Schrottke, Berlin, Germany. App. filed Feb. 12, 1900. (See Current News and Notes.)

697,674. AUTOMATIC TROLLEY CATCHER; T. B. Shanahan, Gloversville, N. Y. App. filed Aug. 7, 1901. A spring drum controlling the trolley cord.

697,696. MACHINE FOR MAKING MICA BOARD; H. F. Watson, Valparaiso, Ind. App. filed Feb. 19, 1901. A machine for turning out mica board in quantities built up of small sheets of mica.

697,698. MAGNETO BELL RINGER; E. E. Yaxley, Chicago, Ill. App. filed Dec. 6, 1901. Details.

697,708. LAMP HOOD AND SWITCH; H. Etheridge, McKeesport, Pa. App. filed July 23, 1901. A construction affording protection to the wires connecting with the hood.

697,727. SWITCH FOR ELECTRIC LAMPS; J. F. Krayer, Philadelphia, Pa. App. filed March 10, 1899. The key is in line with the axis of the lamp socket, the latter being mounted on a gas fixture so that the key appears in the same position as the key of the gas valve.

697,733. MULTIPLE CONDUCTOR SYSTEM; A. D. Lunt, Schenectady, N. Y. App. filed Sept. 27, 1901. (See Current News and Notes.)

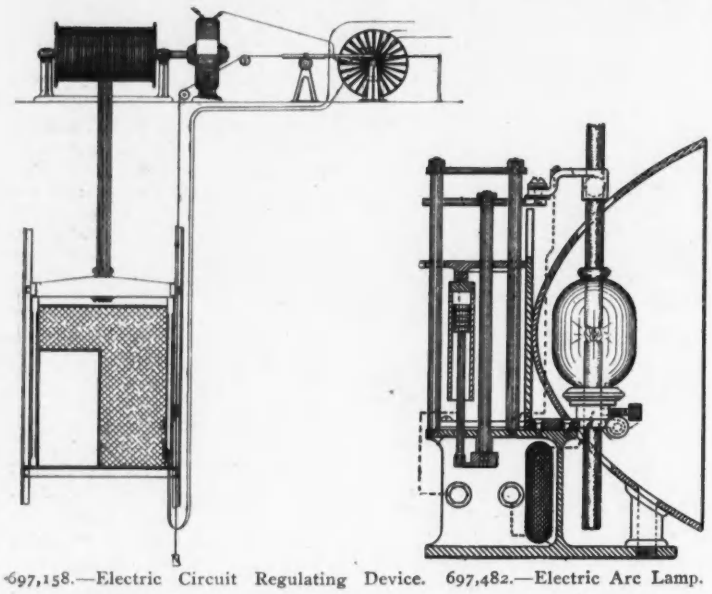
697,734. SAFETY DEVICE FOR CIRCUIT CLOSERS; F. Mackintosh, Schenectady, N. Y. App. filed Aug. 26, 1901. A locking device arranged to cooperate with the line switch and controlled by the rheostat arm so that it is released when the arm stands in the starting position, but is set for operation when the arm is moved to cut out the resistance coil; with this device it is impossible for the line switch to be closed unless the resistance coils are in circuit.

697,749. CONTROLLING DEVICE FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Aug. 29, 1898. (See Current News and Notes.)

697,755. ALTERNATING CURRENT METER; G. Stern, Charlottenburg, Germany. App. filed Aug. 23, 1900. (See Current News and Notes.)

697,756. ALTERNATING CURRENT METER; G. Stern, Charlottenburg, Germany. App. filed Aug. 23, 1900. (See Current News and Notes.)

697,757. GLOBE HOLDER FOR ARC LAMPS; G. E. Stevens, Lynn, Mass. App. filed Sept. 15, 1899. A supporting yoke for a globe holder split longitudinally of its axis to form two jaws, a cylindrical socket between the jaws for the stem of the globe holder, and a set screw to compress or spread the jaws.



697,158.—Electric Circuit Regulating Device. 697,482.—Electric Arc Lamp.

697,767. SYSTEM OF ELECTRICAL CONTROL; G. T. Woods and L. Woods, New York, N. Y. App. filed May 18, 1901. A system of control wherein all of the motors on a car or train are controlled from a single point through the medium of a power-actuated controlling apparatus, the mechanism being such that any one or more of the motors may be cut out if disabled without affecting the control of the others, and each motor car is a unit in itself and may be disconnected from a train and run individually.

697,782. INSULATOR; A. N. Berg and E. E. Bechtold, Chicago, Ill. App. filed Aug. 19, 1901. Details.

697,783. DYNAMO ELECTRIC MACHINE; E. J. Berg, Schenectady, N. Y. App. filed Aug. 25, 1899. (See Current News and Notes.)

697,788. METALLURGICAL CRANE; D. W. Blair, Perth Amboy, N. J. App. filed Jan. 17, 1902. (See page 730.)

697,810. ELECTRIC FURNACE; M. R. Conley, New York, N. Y. App. filed Dec. 5, 1901. (See page 730.)

697,817. DEVICE FOR ELECTRICALLY CONNECTING RAILS; G. Deharde, Wiesbaden, Germany. App. filed Jan. 11, 1900. A hollow split plug is used to fasten the ends of the bonds in the rail.

697,825. NURSERY MILK WARMER AND NIGHT LAMP; J. M. Fisk, Malone, N. Y. App. filed July 27, 1901. An incandescent lamp is surrounded by a jacket into which liquid may be placed to be heated, a small orifice being formed in the jacket for rays of light.

697,826. ELECTRICAL STEERING APPARATUS FOR SHIPS; B. A. Fiske, United States Navy. App. filed Oct. 17, 1900. (See Current News and Notes.)

697,828. TROLLEY POLE; E. L. Fowler, Philadelphia, Pa. App. filed July 11, 1901. The pole is jointed in the middle in such a way that one part can rotate on the other, thus affording lateral movement to the wheel.

697,831. METHOD OF RECOVERING METALS BY ELECTROLYSIS; H. A. Frasch, Hamilton, Canada. App. filed March 7, 1901. (See Current News and Notes.)

697,832. ELECTRIC TRANSMISSION OF POWER; E. M. Fraser, Yonkers, N. Y. App. filed Nov. 6, 1900. Two sets of motors of two each have their armatures of each set mechanically connected while the armature of a motor of each set is in series with an armature of a motor of the other set; the fields are similarly connected and there are means for varying the field of one of the motors of one set. When the field of one of the motors of one set is varied, the speed of one set will be increased and the other decreased, thereby utilizing the current to the best advantage.

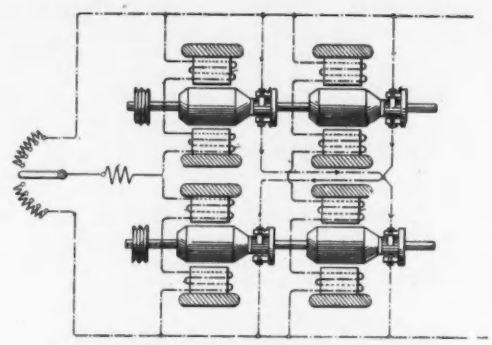
697,834. CIRCUIT CONTROLLER; J. J. Ghegan, Newark, N. J. App. filed Aug. 20, 1901. A compound circuit controller comprising an electro-magnet and its armature, with a second armature actuated by the magnetism induced in the regular armature, the said armatures being provided with contact points. (This instrument is described and illustrated on page 743.)

697,845. CONDUIT FOR ELECTRIC OR LIKE CABLES; C. A. W. Hultman, Stockholm, Sweden. App. filed Jan. 9, 1902. A conduit for electric cables comprising a plurality of tubes, transversely arranged bars interposed between said tubes, longitudinally arranged rods connecting the free ends of said bars and a protecting mass inclosing the tubes.

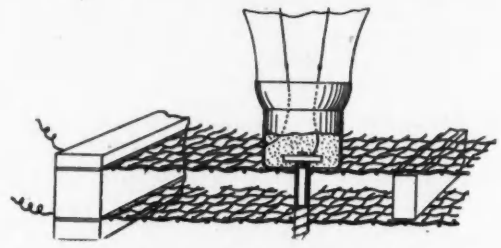
697,847. ELECTRIC ELEVATOR SYSTEM; J. D. Ihlder, Yonkers, N. Y. App. filed Aug. 21, 1901. Controlling means for an alternating current motor, which are operated by rectified current obtained from alternating current instead of being operated as usual by alternating current.

697,849. INDICATING MECHANISM FOR POST OFFICE BOXES; T. F. Kelly, Adair, Iowa. App. filed June 10, 1901. An indicator for mail boxes showing the subscriber when the rent is due.

697,856. CONTACT FOR ELECTRICAL GLOW LAMPS; A. Lefebre, Paris, France. App. filed Nov. 11, 1901. Two sheets of wire mesh, one behind the other and respectively in circuit with the positive and negative mains, are arranged to support lamps whose bases are fitted with pins adapted to pass through the mesh, one pin contacting with one mesh and the other pin with the other mesh, to establish a circuit through the lamp.



697,832.—Electric Transmission of Power.



697,856.—Contact for Electrical Glow Lamps.

697,884. TROLLEY POLE; W. Pullman and C. C. Field, Sodus, N. Y. App. filed Oct. 11, 1901. Details.

697,890. RAIL BOND; B. C. Rowell, Chicago, Ill. App. filed July 21, 1900. A slotted conical hollow plug for holding the end of the bond.

697,892. TROLLEY WHEEL; W. Sellers, Haverhill, Mass. App. filed Jan. 31, 1902. Details.

697,928. MOTOR CONTROLLING APPARATUS; G. T. Wood and L. Woods, New York, N. Y. App. filed Sept. 3, 1901. The system in general is indicated by the following claim:

The combination of a train having a plurality of electrically equipped cars, each of such equipments having a motor controller with spring-pressed contacts and a commuting switch to energize the controller section by section, and means adapted to make a direct electrical connection between the commuting switch on car and a like device on another car independently of the sequence of the equipped cars.

697,930. RAIL CHAIR AND INSULATOR; W. D. Young, Baltimore, Md. App. filed March 5, 1901. An insulator and support for a third rail.

697,934. RAILWAY SAFETY BLOCK SYSTEM; G. W. Cohen, Allegheny, Pa. App. filed Aug. 8, 1901. An automatic system in which the trains set and release the signals at the ends of the blocks.

697,935. PLURAL FUSE CUT-OUT; C. J. Dorsey, Baltimore, Md. App. filed Nov. 26, 1900. Details of a magazine fuse block.

697,937. TROLLEY WIRE HANGER; I. L. Edwards, Aurora, Ill. App. filed Jan. 29, 1902. A trolley wire hanger having shiftable means for engaging a stringer wire comprising a bar having hooks, a slotted screw-threaded stud, and a nut on the stud to directly engage the stringer wire, the hooks and slot in the stud being in alignment, whereby bending or kinking of the wire is obviated.